United States Court of Appeals for the Federal Circuit

2007-1164

BROADCOM CORPORATION,

Appellant,

v.

INTERNATIONAL TRADE COMMISSION,

Appellee,

and

QUALCOMM INCORPORATED,

Intervenor.

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Appealed from: United States International Trade Commission

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On appeal from the United States International Trade Commission in Investigation No. 337-TA-543.

DECIDED: September 19, 2008

Before RADER, BRYSON, and LINN, Circuit Judges.

BRYSON, Circuit Judge.

This appeal arises out of an investigation by the International Trade Commission under section 337 of the Tariff Act of 1930, 19 U.S.C. § 1337. Broadcom Corporation filed a petition with the Commission alleging that Qualcomm Incorporated had imported chipsets that infringed five of Broadcom's patents in violation of section 337: U.S. Patent No. 5,682,379 (the '379 patent), U.S. Patent No. 6,359,872 (the '872 patent),

U.S. Patent No. 6,374,311 (the ’311 patent), U.S. Patent No. 6,583,675 (the ’675 patent), and U.S. Patent No. 6,714,983 (the ’983 patent). The administrative law judge dismissed the claims that were based on the ’379 and ’872 patents after the United States District Court for the Southern District of California ruled that a forum selection clause required those patents to be litigated in California.

Following a hearing, the administrative law judge found that Qualcomm had violated section 337 by inducing infringement of the ’983 patent. Based on that determination, the Commission ultimately issued an exclusion order barring the importation of devices containing Qualcomm’s baseband processor chips. After the President declined review, Qualcomm and a number of handset device manufacturers and service providers appealed the Commission’s order. Those appeals were consolidated in Kyocera Wireless Corp. v. International Trade Commission, Nos. 2007-1493 et seq., which is now pending before this court.

With respect to the ’311 and ’675 patents, however, the administrative law judge found no violation of section 337, ruling that Qualcomm’s chipsets did not infringe the claims of those two patents. After the Commission adopted the administrative law judge’s noninfringement determinations, Broadcom filed this appeal. We affirm the Commission’s noninfringement determination as to the ’311 patent, but we vacate the noninfringement determination as to the ’675 patent in part, and we remand for further proceedings.

I

As a preliminary matter, we address a jurisdictional argument raised by Qualcomm. Qualcomm asserts that Broadcom’s petition for review was untimely

because Broadcom filed its petition for review once the Commission issued its December 2006 order adopting the administrative law judge's findings of noninfringement. In Qualcomm's view, the Commission's order did not become final and appealable until after the President declined review of the Commission's exclusion order based on the '983 patent.

Qualcomm's argument lacks merit in light of our decision in Allied Corp. v. United States International Trade Commission, 782 F.2d 982 (Fed. Cir. 1986). In Allied, the Commission found one of three asserted patents to be valid and infringed. For the other two patents, the respondent succeeded in proving invalidity as a defense to infringement. The Commission adopted the invalidity determinations on July 6, 1984, and Allied sought to appeal those determinations to this court. Allied did not file its petition for review until February 13, 1985, however. We dismissed Allied's petition as untimely because it was filed more than 60 days after the Commission adopted the invalidity determinations. The Commission's adoption of the invalidity determinations was final, we held, because there was "no provision for Presidential review, or for other administrative proceedings, following a determination that does not lead to an exclusion order." Id. at 984. In this case, similarly, once the Commission adopted the administrative law judge's noninfringement determination, there was no further opportunity for review of that decision other than by way of review in this court. Broadcom therefore did not prematurely file its petition for review once the Commission issued its order.

Qualcomm makes the additional argument that this court lacks jurisdiction to hear Broadcom's appeal with respect to the '311 patent. Qualcomm asserts that even if

Broadcom were to succeed in its appeal, the Commission would nevertheless lack statutory authority to provide relief because the '311 patent claims a network while Qualcomm merely imports a component of the network. Qualcomm therefore argues that any decision of this court with respect to the '311 patent would be merely advisory. We believe Qualcomm's argument is better viewed as an alternative argument in support of the Commission's determination that Qualcomm did not violate section 337 by importing an article that infringes the '311 patent. This court has jurisdiction to review decisions of the Commission as to whether particular conduct violates section 337, see 19 U.S.C. § 1337(c), and thus we would have jurisdiction to review a ruling that Qualcomm's conduct did not violate section 337 despite infringing the '311 patent. In any event, however, the Commission based its decision that no section 337 violation occurred on its determination that Qualcomm did not infringe the '311 patent, a determination that we plainly have jurisdiction to review.

II

A

The '311 patent covers a communication network. One aspect of the disclosed network is the ability for terminal nodes (e.g., handsets) and network access points to synchronize their operation in order to allow the terminal nodes to operate in a power-saving state. See '311 patent, col. 15, ll. 44-54. According to the written description, a terminal node may enter a "Sleep State" in which it can power down. Id. If a terminal node is "Sleeping," the network access point will temporarily store messages addressed to the Sleeping node for delivery at a later time. Id. At synchronized intervals, the network access point will transmit a "Hello" message, and Sleeping terminal nodes will

wake up in order to receive the transmission. Id. Any messages that have been stored by the network access point will be transmitted to the terminal node after the Hello message is sent. Id.

Broadcom asserted infringement of claims 1 and 16 and their dependent claims. Claim 1 of the '311 patent recites:

> A communication network supporting wireless communication of messages, said communication network comprising:
>
> a first terminal node having a wireless receiver operable in a normal state;
>
> a second terminal node having a wireless receiver operable in a power-saving state;
>
> an access point that attempts to immediately deliver messages destined for the first terminal node;
>
> the access point attempts to deliver messages destined for the second terminal node by transmitting at predetermined intervals beacons that identify that a message awaits delivery;
>
> the second terminal node synchronizes operation of its wireless receiver to receive the beacons from the access point; and
>
> the second terminal node determines from the received beacons that it has a message awaiting delivery and directs further operation of its wireless receiver to receive the message.

Claim 16 of the '311 patent similarly recites:

> A communication network supporting wireless communication of messages, said communication network comprising:
>
> a first terminal node operating in a first state;
>
> a second terminal node operating in a second state in which attempts are made to minimize power consumption by the wireless receiver[;]
>
> a bridging node having a wireless transceiver to support wireless communication to the first and second terminal nodes;
>
> the bridging node attempts to deliver messages destined for the second terminal node by transmitting at predetermined intervals beacons that identify a message awaiting delivery;

> the second terminal node synchronizing operation of its wireless receiver to receive the beacons from the bridging node and determining from the received beacons that it has a message awaiting delivery and responding to an awaiting message by directing further operation of its wireless receiver to receive the message; and
>
> the bridging node delivering messages to the first terminal node without requiring the first terminal node to determine from the beacons that it has messages awaiting delivery.

Broadcom's theory of infringement was that Qualcomm manufactures chipsets that are used in wireless handsets on third-generation wireless networks that use a wireless communication standard developed and promoted by Qualcomm ("the EV-DO standard"). The EV-DO standard ensures compatibility between terminals (e.g., handsets) and networks by defining a series of "Connection Layer Protocols." The protocols pertinent to this case are the "Connected State Protocol" and the "Idle State Protocol." The Connected State Protocol describes the interaction of the network with a terminal while the terminal is in active use, such as when the terminal is sending or receiving a voice or data transmission. The Idle State Protocol describes the interaction of the network with a terminal after a period of inactivity. In the Idle State Protocol, the network and terminal may cycle through two states: a "Monitor State" in which the terminal monitors a "Control Channel," and a "Sleep State," which the terminal may enter if it detects no messages on the Control Channel.

According to Broadcom, EV-DO compliant networks necessarily infringe claims 1 and 16 of the '311 patent because the EV-DO standard's Idle State Protocol requires networks to implement power-saving features. Broadcom therefore asserted direct infringement based on Qualcomm's use of its chipsets in handsets on its own test network in the United States. Broadcom also argued that Qualcomm induced infringement of the asserted claims based on Qualcomm's promotion of the EV-DO

standard. The administrative law judge rejected Broadcom's assertion of direct infringement, finding that Broadcom's evidence was insufficient to prove that Qualcomm's handsets operated in a "power-saving state" at any point during the testing process. With respect to Broadcom's claim of induced infringement, the administrative law judge agreed with Broadcom that third-party EV-DO networks directly infringed claim 1. The administrative law judge nevertheless rejected Broadcom's theory of induced infringement, finding that the EV-DO standard does not require handsets used on EV-DO compliant networks to operate in a power-saving state. The administrative law judge therefore found that Qualcomm lacked the requisite level of intent to induce infringement of the claims of the '311 patent.

B

Broadcom's primary argument on appeal is that EV-DO compliant networks necessarily infringe the claims of the '311 patent and therefore the administrative law judge's conclusions with respect to direct and induced infringement are both incorrect. Broadcom asserts that under the EV-DO standard, networks must implement the Idle State Protocol's Sleep State and that the Sleep State involves powering down a handset's wireless receiver. Qualcomm and the Commission respond that handsets implementing the Sleep State are not required to power down their wireless receivers while in the Sleep State. Qualcomm further argues that the EV-DO standard does not require handsets even to enter the Sleep State because the standard allows for handsets to operate in a "continuous operation" mode in which the handset continuously monitors the channel from which it receives messages.

The administrative law judge relied on the first argument pressed by Qualcomm and the Commission, and we affirm on that basis. The EV-DO standard provides that a terminal in the Sleep State "may shut down part of its subsystems to conserve power" and that the terminal "may shut down processing resources to reduce power consumption." The EV-DO specification makes clear that the use of the word "may" instead of "shall" indicates that a certain feature is not required by the standard. According to the EV-DO specification,

> "Shall" and "shall not" identify requirements to be followed strictly to conform to the standard and from which no deviation is permitted. . . . "May" and "need not" indicate a course of action permissible within the limits of the standard.

Based on the language of the EV-DO specification, Mr. Grob, one of Qualcomm's experts, testified that handsets are not required to conserve battery power in the Sleep State and that whether a handset powers down the wireless receiver depends on whether the handset's vendor decides to implement that feature. In response to that testimony, Broadcom relies only on general testimony regarding the operation of handsets under the EV-DO standard. Although portions of the testimony Broadcom cites include statements that handsets power down their wireless receivers in the Sleep State, Broadcom cites no evidence to suggest that terminals must do so in order to be compatible with EV-DO networks.

Moreover, we agree with Qualcomm that the EV-DO standard does not require handsets to implement the Sleep State. Broadcom cites four passages from the EV-DO specification to support its contention that the Sleep State is a mandatory feature. Those passages, however, do not support Broadcom's position. The first three passages on which Broadcom relies describe the requirements of the network, not the

handsets. For instance, the EV-DO specification states that the "[a]ccess network shall transition from the Sleep State if the access terminal did not advertise a suspend period that is current." The corresponding requirement for handsets operating on the network provides that the "access terminal may transition to the Sleep State if . . . [the] [a]ccess terminal has not advertised a suspend period that is current." And although the fourth passage on which Broadcom relies actually describes the requirements for handsets, that passage does not support Broadcom's position because it describes requirements for handsets that have entered the Sleep State, stating that "the access terminal shall transition from the Sleep State to the Monitor State in time to send and receive, respectively, the synchronous capsule." Qualcomm, on the other hand, points out that the EV-DO specification explicitly provides that handsets do not need to enter the Sleep State, where the specification states that an access terminal may operate in a continuous operation mode "in which the access terminal continuously monitors the Control Channel."

Even though the EV-DO standard does not require handsets to operate in a power-saving state, Broadcom also argues that the administrative law judge should have nevertheless made a finding of intent to induce infringement based on Qualcomm's promotion of the EV-DO standard's optional features. The Commission and Qualcomm, however, assert that Broadcom never presented that argument to the administrative law judge. In response, Broadcom does not point to anything in the record to show that it made that inducement argument to the administrative law judge. Broadcom therefore may not rely on that argument on appeal.

C

Broadcom also argues that the administrative law judge erred by not directly addressing infringement of claim 16. That argument is without merit. When addressing Broadcom's assertion of direct infringement, the administrative law judge explicitly stated that Broadcom failed to introduce "evidence that Qualcomm's test networks contain . . . 'a second terminal node operating in a second state in which attempts are made to minimize power consumption by the wireless receiver,' as recited in independent claim 16." With regard to Broadcom's claim of induced infringement, the administrative law judge found that Broadcom provided "insufficient proof to show that Qualcomm intended to induce infringement of the particular asserted claims." Broadcom challenges that conclusion with respect to claim 16 by arguing that, even if EV-DO compliant networks do not necessarily infringe claim 1, they nevertheless must infringe claim 16. Broadcom argues that, even if handsets are not required to power down their wireless receivers in the Sleep State, they will nevertheless "minimize power consumption by the wireless receiver" simply by not being in the Monitor State. As noted earlier, however, handsets are not required by the EV-DO standard to enter the Sleep State, but instead may operate in a continuous operation mode in which they remain continuously in the Monitor State. In any event, Broadcom waived its argument regarding claim 16 by not raising it before the Commission in its petition for review of the administrative law judge's decision. See Finnigan Corp. v. Int'l Trade Comm'n, 180 F.3d 1354, 1362 (Fed. Cir. 1999) ("A party seeking review in this court of a determination by the Commission must 'specifically assert' the error made by the ALJ in its petition for review to the Commission.").

D

Finally, Broadcom asserts that the administrative law judge erred by requiring Broadcom to prove actual use of a handset in a power-saving state, rather than only requiring Broadcom to show that Qualcomm used handsets containing chipsets capable of being used in a power-saving state. The Commission and Qualcomm respond that Broadcom waived that argument. The Commission asserts that Broadcom waived the argument by not raising it before the administrative law judge, while Qualcomm asserts that Broadcom waived the argument by failing to raise the argument in its petition for review to the Commission. As to the merits, the Commission and Qualcomm present different arguments. The Commission argues that the administrative law judge did not in fact require Broadcom to show that Qualcomm actually used its handsets in a power-saving state. Qualcomm, however, argues that proof of infringement of the asserted claims requires proof of actual operation of a handset in a power-saving state.

First, we agree with Broadcom that the administrative law judge required proof that Qualcomm's handsets were actually operated in a power-saving state, but we agree with the Commission that Broadcom failed to raise that issue before the administrative law judge. Qualcomm and Broadcom presented to the administrative law judge different constructions of the claim term "a second terminal node having a wireless receiver operable in a power-saving state." Qualcomm argued that, to meet that claim limitation, the second terminal node must always operate in the power-saving state—i.e., that the power-saving state must be an immutable mode of operation. Broadcom argued that the claim "requires only that the 'wireless receiver' must be capable of being turned off." The Commission's staff sided with Broadcom, asserting

that "the claim only requires that at a given time there are at least two terminals—one with its receiver powered up and one with its receiver in the power-saving state." Broadcom quoted that passage in its post-trial reply brief and stated that the staff had "correctly articulated" the requirement for proof of the "second terminal node" limitation. The administrative law judge therefore held that "a second terminal node having a wireless receiver operable in a power-saving state" required that "at some point in time, the second terminal node [is] in a 'power-saving' state." Based on Broadcom's statement in its post-trial reply brief, we conclude that Broadcom did not adequately present to the administrative law judge the argument it now presents on appeal—that no proof of actual use was required. Broadcom has therefore waived that argument by failing to preserve it in the proceedings before the administrative law judge. See Corus Staal BV v. United States, 502 F.3d 1370, 1378 n.4 (Fed. Cir. 2007); Hazani v. Int'l Trade Comm'n, 126 F.3d 1473, 1476-77 (Fed. Cir. 1997).

Second, we agree with Qualcomm that Broadcom waived its argument by not raising it before the Commission in its petition for review. In response to Qualcomm's argument, Broadcom cites two passages from its petition for review. The first passage is a general description of the patents involved in the investigation. The second passage relates to an argument that it is not the "terminal node" but the "wireless receiver" that must be operable in a "power-saving state." Broadcom also relies on a third passage that does not appear in its petition for review, but rather appears in its response to Qualcomm's petition for review. A review of those passages, however, shows that Broadcom did not specifically assert, in its petition for review, the claim of

error that it now seeks to raise in this court. Broadcom's argument is therefore barred by the failure to raise it before the Commission. See Finnigan, 180 F.3d at 1362.

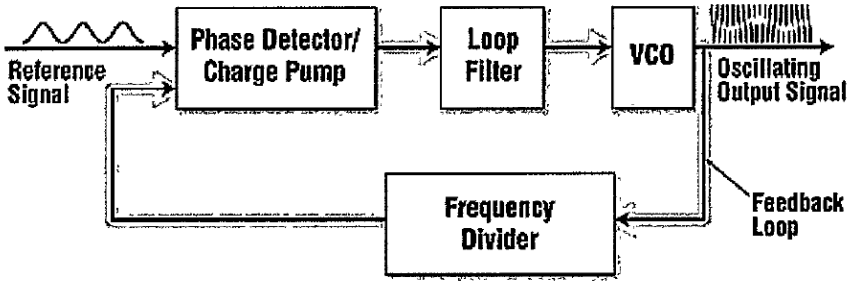
Qualcomm raises two additional grounds for affirming the Commission's determination: that the administrative law judge should have adopted its claim construction of "beacons" as used in claims 1 and 16, and that the '311 patent is invalid. We do not address those arguments because we affirm the Commission's determination on the basis of the administrative law judge's noninfringement findings. See Solomon Techs. v. Int'l Trade Comm'n, 524 F.3d 1310, 1319-20 (Fed. Cir. 2008) ("If we uphold the Commission's order . . . we are not required to address every possible ground on which the Commission's order might be sustained.").

III

A

We now turn to the Commission's determination that there was no section 337 violation with respect to the '675 patent. The '675 patent relates to circuits for transmitting and receiving radiofrequency ("RF") signals. Devices that transmit or receive RF signals process information from those signals at a much lower frequency than the frequency of the RF signal itself. The lower frequency signal is commonly known as a "baseband signal." Transmitting an RF signal therefore requires converting the baseband signal to a higher frequency. That step is performed by a mixer, or modulator, which combines the baseband signal with an oscillator signal that is tuned to the desired output frequency. '675 patent, col. 1, ll. 13-15.

RF transmitters commonly use a circuit called a phase lock loop ("PLL"), pictured below, to generate the oscillator signal. '675 patent, col. 1, ll. 23-27.



A PLL is a feedback loop that uses a voltage controlled oscillator ("VCO") to generate the oscillator signal from an input reference signal. The VCO contains a circuit known as an LC circuit that contains multiple fixed capacitors in parallel with an inductor and a varactor diode (i.e., a variable capacitor). The LC circuit therefore has a resonant frequency that depends on the capacitance of the fixed capacitors and on the capacitance of the varactor diode. The resonant frequency—which sets the frequency of the oscillator signal—can be tuned in two ways. Switching in or switching out the fixed capacitors provides a means for coarse tuning the frequency, while varying the voltage across the varactor diode provides a means for fine tuning the frequency. Id., col. 1, ll. 43-58.

For fine tuning the frequency of the oscillator signal, the voltage across the varactor diode is adjusted by comparing the input reference signal to the oscillator signal, which ideally has a frequency that is a multiple of the frequency of the input reference signal. To compare the signals, the oscillator signal is passed through a frequency divider. The frequency divided oscillator signal and the input reference signal are both provided as inputs to a phase detector. If the two signals are in phase, no adjustment to the voltage across the varactor diode is necessary. If the two signals are out of phase, the phase detector sends an error signal to a charge pump, which

increases or decreases the voltage across the varactor diode in order to "shift" the frequency of the oscillator signal. '675 patent, col. 6, ll. 1-23.

In VCOs that use varactor diodes, adjusting the voltage across the varactor diode to achieve the desired change in the frequency of the oscillator signal can be problematic. That is because the "VCO gain" is not constant. VCO gain is defined as the amount by which the frequency of the oscillator signal shifts divided by the change in the voltage across the varactor diode. VCO gain is not constant because a given voltage applied to the varactor diode will cause a different frequency shift in the oscillator signal for each combination of fixed capacitors that is switched in to the LC circuit. '675 patent, col. 1, ll. 59-64.

To solve that problem, a "gain compensation circuit" can be added to a PLL. A gain compensation circuit provides a "reference pump current" to the charge pump. The magnitude of that current is calculated based on the particular set of fixed capacitors in the LC circuit that is switched in. As a result, the charge pump adjusts the voltage it applies across the varactor diode to compensate for the amount of VCO gain caused by the fixed capacitor set that is switched in. '675 patent, col. 2, ll. 11-34. As shown in Figure 4 of the '675 patent, an ideal gain compensation circuit cancels out the VCO gain so that the overall gain is constant:

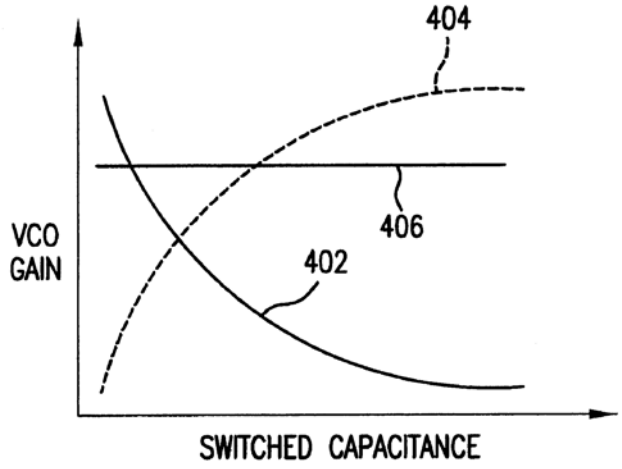


FIG. 4

Line 402 represents the VCO gain, which varies with the capacitance of the LC circuit. Line 404 indicates gain compensation resulting from reference pump current applied to the charge pump by the gain compensation circuit. The result, indicated by line 406, is effectively constant VCO gain. '675 patent, col. 8, ll. 16-30.

The invention of the '675 patent is a gain compensation circuit. The circuit generates the reference pump current from groups of unit current sources. The unit current sources are in parallel and generate current that is equal in magnitude to a "reference scale current." Each group of unit current sources corresponds to a fixed capacitor in the VCO. If a certain fixed capacitor is switched in to the VCO during operation of the PLL, the gain compensation circuit switches in the corresponding group of unit current sources, and the reference charge pump current is generated by summing together the currents from each unit current source. The result is that the magnitude of the reference charge pump current depends on which fixed capacitors of the VCO are switched in. '675 patent, col. 2, ll. 38-56.

The patent further discloses using a current scaler to set the reference scale current in order to allow the PLL to be used in different operating environments. For instance, it may be desirable to set the reference scale current to operate with different input reference frequencies. '675 patent, col. 9, ll. 16-22. The patent therefore describes using a current scaler to set the reference scale current based on a "PLL control signal," a signal that represents certain PLL characteristics such as input reference frequency, loop bandwidth, or a damping factor. Id., col. 9, ll. 16-18. One embodiment of a current scaler disclosed in the patent uses "weighted" current sources whose individual weights are based on the PLL control signal. The currents from the weighted current sources are summed together to generate the reference scale current. Id., col. 11, line 63, to col. 12, line 18.

Claim 33 of the '675 patent recites:

> A gain compensator circuit that determines a reference pump current for a charge pump in a phase lock loop (PLL), comprising
>
> a plurality of unit current sources that are arranged into at least one group, said group responsive to a capacitor control signal and generating a portion of the reference pump current when said group is activated, wherein said capacitor control signal also controls a corresponding fixed capacitor of a voltage controlled oscillator (VCO) in the PLL; and
>
> a current mirror including one or more weighted current sources that generate a reference scale current responsive to a PLL control signal, the PLL control signal representative of one or more characteristics of the PLL,
>
> each of said unit current sources generating a unit current proportional to said reference scale current, said unit currents summed together to form the reference pump current.

Broadcom accused eight of Qualcomm's chips of infringing claim 33 and claim 35, a dependent claim of claim 33. Five of the chips are transmitter chips, which upconvert baseband signals to RF signals. The remaining three chips are transceiver

chips, which downconvert RF signals to baseband signals in addition to performing the function of the transmitter chips. Each of the chips has a PLL that includes a gain compensation circuit. The gain compensation circuits are divided into two planes, an upper plane and a lower plane. Each plane is composed of transistors that form a current mirror—a circuit that replicates an input current.

The lower plane in Qualcomm's chips has a fixed current of 50 μA on the input side of the current mirror. The output side of the current mirror contains a series of groups of transistors in parallel that can replicate the 50 μA input current. The groups of transistors on the output side of the current mirror are turned on or off by a "CT signal." The CT signal is the signal used by the PLL's VCO for coarse frequency tuning. It therefore indicates which capacitors in the VCO are switched in. In the gain compensation circuit, the CT signal turns on each group of transistors that corresponds to a capacitor that is switched in to the VCO. The transistors that are turned on replicate the 50 μA current, while those that are turned off generate no current. It is undisputed that the lower plane in Qualcomm's chips satisfies the first limitation of claim 33. The transistors are "unit current sources," and they are turned on or off by the CT signal, which is a "capacitor control signal."

The output of the lower plane is the sum of the currents generated by the transistors that are turned on. That output current flows to the input of the gain compensation circuit's upper plane. Qualcomm's chips have two different designs for the upper plane. The RFT6150 chip has a current mirror in the upper plane in which the sole input is the output from the lower plane. The output side of the current mirror has groups of transistors in parallel that can replicate the input current from the lower plane.

The transistors are turned on or off by a REF signal. The output of the second mirror—the reference pump current—is the sum of the currents of the transistors that are turned on by the REF signal. As implemented by Qualcomm's chips, the REF signal does not change during operation. The chips' designer, Mr. Dunworth, testified that he originally intended for the REF value to be used as "the expected value of the course tuning code" and that it "would change with the VCO frequency." But instead, the REF value "is always hard coded to one value which is fixed as a constant value in the binary source code provided by Qualcomm and that users of that code [do] not have access to."

In the other seven accused chips, the current from the lower plane is used differently. The current from the lower plane is divided among groups of transistors in parallel. Four of the groups of transistors are turned on or off by the REF value. The fifth group of transistors provides the input current to a current mirror. On the output side of the current mirror, a set of transistors replicates the input current, generating the reference pump current, which flows to the charge pump.

The administrative law judge found that none of Qualcomm's chips infringe claim 33. For the RFT6150 chip, the administrative law judge found no infringement because the REF value did not qualify as a "PLL control signal." Based on the testimony of Dr. Milor, one of Broadcom's experts, that a "control signal" must be "changeable," the administrative law judge ruled that REF value was not a control signal because it is hard coded so that "consumers cannot change [it]." For the remaining seven chips, the administrative law judge found no infringement on the ground that the transistors in the lower plane did not satisfy the "weighted current sources" limitation, because the

transistors act as a current divider rather than as current sources. Broadcom challenges both of those conclusions.

B

Broadcom argues that the administrative law judge's finding of noninfringement for the RFT6150 chip was based on a misunderstanding of Dr. Milor's testimony. Broadcom asserts that, according to Dr. Milor's testimony, a control signal is "changeable" if it is implemented in software, even if the control signal has a hard coded value. The Commission argues that the administrative law judge's conclusion is correct because the REF value is not "changeable" if users of the binary code distributed by Qualcomm cannot change the coded REF value. Qualcomm supports the Commission, arguing that the REF value would have to change during actual operation of the PLL in order for the REF value to be a "PLL control signal." We agree with Broadcom that Dr. Milor's testimony does not support the administrative law judge's finding.

The administrative law judge's construction of "PLL control signal" contained no requirement that a customer be able to change the value of the control signal. Rather, the administrative law judge construed "PLL control signal" to mean "a control signal representative of some characteristic of the PLL." When applying that definition to Qualcomm's RFT6150 chip, however, the administrative law judge began by analyzing whether the REF value was a "control signal." The administrative law judge then adopted Dr. Milor's statement that a control signal "has got to be changeable" as a definition for the phrase "control signal." The administrative law judge therefore found that the REF value was not a control signal because it could not be changed by Qualcomm's customers and because Qualcomm did not intend for its customers to

change the value. That conclusion, however, is not supported by Dr. Milor's testimony. In fact, Dr. Milor testified that the REF value is a "PLL control signal" because it has a value in Qualcomm's software that could be changed by Qualcomm's programmers. She stated that a control signal must be "changeable" to distinguish a signal that is hardwired into a circuit from a signal that is coded by software. Nowhere does Dr. Milor's testimony indicate that, in her view, a control signal is "changeable" only if Qualcomm's customers can change its coded value. Dr. Milor's view was that the REF value is "changeable" because the value that is hard coded into Qualcomm's software can be changed by Qualcomm. Therefore, if the administrative law judge adopted Dr. Milor's definition of "control signal," the opposite conclusion was warranted. The testimony of Mr. Dunworth, relied on by the administrative law judge and by the Commission and Qualcomm on appeal, does not change the result under Dr. Milor's definition. Mr. Dunworth's testimony that the REF value is hard coded in software by Qualcomm's programmers simply confirms that the REF value could be changed by Qualcomm.

Moreover, the written description of the patent does not suggest that users of a device using a radiofrequency transmitter must be able to change control signals in the PLL. Indeed, an example of the '675 patent indicates why it would be useful to have a hard coded value for a PLL control signal. If a designer had to adjust a PLL to work with a reference signal having twice the frequency of the original reference signal, the designer might need to replace the frequency divider. But if the reference scale current is controlled by a PLL control signal, the designer could simply adjust the coded value for the PLL control signal in order to divide the reference scale current by two. See '675

patent, col. 12, ll. 34-50. That example shows that using a PLL control signal to adjust the reference scale current can provide a benefit to the designer of a PLL, even if the value for the PLL control signal remains the same after the PLL's final design is completed.

In addition, we reject Qualcomm's argument that the administrative law judge's noninfringement finding should be affirmed on the basis that a "PLL control signal" must change during actual operation of the circuit. The administrative law judge never construed the phrase in that manner; in any event, Qualcomm's claim construction is contrary to the most reasonable interpretation of the claims of the '675 patent. Claim 37, which depends from claim 33, recites a gain compensator circuit in which the reference pump current is "responsive to variations in said one or more characteristics of the PLL." Qualcomm's argument that the PLL control signal must change during operation to reflect changes in a characteristic of the PLL would make claim 37 redundant, a consequence that renders the argument suspect. See nCube Corp. v. SeaChange Int'l, Inc., 436 F.3d 1317, 1321-22 (Fed. Cir. 2006).

Broadcom further argues that the record supports the conclusion that the REF value is a PLL control signal, asserting that the REF value is "representative of some characteristic of the PLL," as the administrative law judge's construction requires. The administrative law judge, however, did not reach that question. We therefore remand the case for the Commission to determine whether the REF value meets that limitation and, if so, whether Qualcomm's RFT6150 chip satisfies the other limitations of claim 33.

C

With respect to the remaining seven chips, we hold that the administrative law judge's noninfringement determination is supported by substantial evidence. Broadcom first argues that the administrative law judge's analysis of the "weighted current sources" limitation was erroneous because he did not determine whether the individual transistors were "weighted current sources," but instead looked at the entire plane containing the identified transistors. That argument is without merit. The administrative law judge found that "the weight of the evidence indicates that, with respect to each accused product except the RFT6150, the highlighted transistors . . . are not current sources, and therefore, also cannot be 'weighted current sources' as required by the claim." Although the administrative law judge relied on Mr. Gutierrez's testimony that the upper plane "does not . . . control the magnitude of the current that flows through it, and, therefore, it is not a current source, but rather a current splitter," other portions of Mr. Gutierrez's testimony make clear that he viewed the individual transistors as branches of a current divider and not as current sources.

Turning to whether the transistors in the upper plane could be considered "current sources," the administrative law judge identified two types of current sources based on testimony from Dr. Milor: independent and dependent current sources. Independent current sources produce a current of fixed magnitude. It is undisputed that the transistors at issue are not independent current sources. Dependent current sources, on the other hand, "generate[] a current as a function of another voltage or current." The magnitude of the currents passing through the upper plane transistors depends on two factors: the REF value and the magnitude of the current flowing out of

the lower plane. That is, the current flowing from the lower plane is divided into the groups of transistors that are turned on by the REF value. Mr. Gutierrez therefore testified that transistors in the upper plane "are not acting as current sources," but rather, they "are acting as the termination of the currents in the bottom." Although Dr. Milor testified that the transistors could be considered dependent current sources, she agreed that the current flowing through those transistors would have no effect on the current in the lower plane. That is, the transistors in the lower plane are the current sources that determine the magnitude of the current flowing through the upper plane. The administrative law judge therefore reasonably concluded that the individual transistors do not generate current but instead act as branches of a current divider. Accordingly, we affirm the finding of noninfringement of the '675 patent with respect to the seven chips other than the RFT6150 chip.

IV

In sum, we affirm the Commission's determination that Qualcomm's chipsets do not infringe the '311 patent. We vacate in part the Commission's determination with respect to the '675 patent and remand for the Commission to determine whether the REF value of RFT6150 circuit is "representative of some characteristic of the PLL" and whether the RFT6150 meets the remaining limitations of claims 33 and 35 of the '675 patent. With respect to the '675 patent as applied to the remaining chips, we affirm the Commission's determination of noninfringement.

Each party shall bear its own costs for this appeal.

AFFIRMED IN PART, VACATED IN PART, and REMANDED.