PATROLL Winning Submission

U.S. Patent 8,456,365

U.S. Patent 8,456,365 ("*Fractus*" or the "patent-at-issue") was filed on August 13, 2008 and claims the benefit of International Patent Application PCT/EP2002/014706, filed on December 22, 2002. Claim 31 of the patent-at-issue is generally directed to a mobile communication device comprising a device housing, a printed circuit board (PCB) with a ground plane layer and a feeding point, a communication circuitry mounted on the PCB and coupled to the feeding point and to the ground plane layer, and a multi-band antenna capable of operating at multiple frequency bands. The multi-band antenna includes a dielectric mounting structure with a plurality of surfaces and an antenna element coupled to the feeding point and operating in cooperation with the ground plane layer. The antenna element also comprises a first radiating arm arranged on two or more surfaces of the dielectric mounting structure and comprised of a first section shaped according to a grid-dimension curve and a second section connected to the grid-dimension section. The second section also has a different width from the first section. The PCB, the communication circuitry, and the multi-band antenna are all arranged inside the device housing.

The primary reference, U.S. Patent No. 7,319,432 ("*Sony*"), was filed on March 11, 2003 and claims the benefit of priority from U.S. Provisional Application Ser. No. 60/366,514, filed on March 19, 2002. The patent generally relates to a multi-band radio antenna device for a radio communication terminal, comprising a flat ground substrate, a flat main radiating element having a radio signal feeding point, and a flat parasitic element. The main radiating element is located adjacent to and in the same plane as said ground substrate, and preferably dielectrically separated therefrom. The antenna device is suitable for being used as a built-in antenna in portable radio terminals, such as a mobile phone.

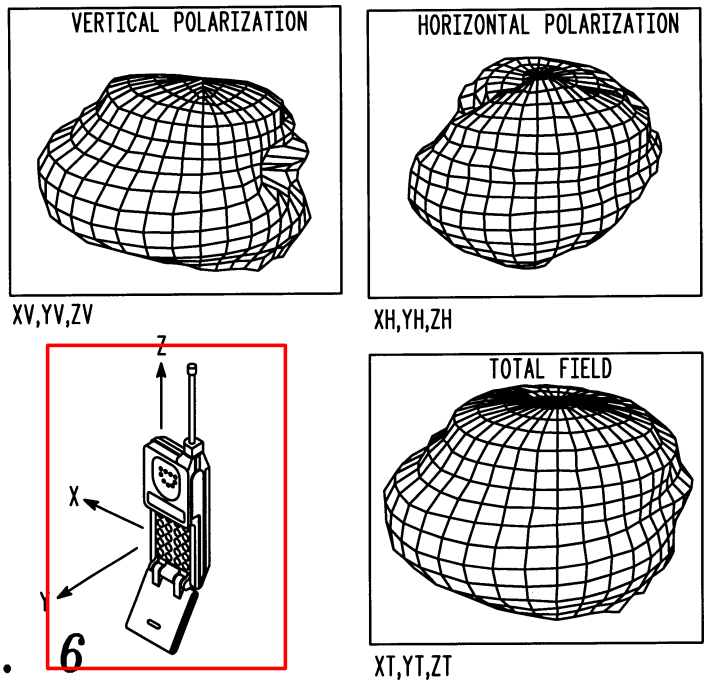
The secondary reference, U.S. Patent No. 6,466,170 ("*BlackBerry*"), was filed on March 28, 2001 and claims priority on the same date. The patent generally relates to an internal multi-band antenna for a mobile communication device having a planar radiating element and a ground plane conductor disposed substantially parallel thereto with a dielectric, such as air or a substrate, therebetween. The radiating element includes at a feed point, for example, a feeding strap, which may have an L-shape. One or more shorting straps are selectively connected between the radiating element and the ground conductor, positioned relative to the feed point for tuning the input impedance at the feed point, and for tuning the resonant frequency of the planar radiating element. The radiating element includes an angled slot having at least three slot sections, for example, N, M, W shapes and the like, mutually coupled at a second resonant frequency to increase resonant frequency bandwidth. The feeding strap and one or more shorting straps may be provided as inverted L straps for a series LC impedance.

Patent Owner is now on notice that claims of this patent are invalid; as a result, any new or continued assertion of this patent may be considered meritless or brought in bad faith. *Octane Fitness, LLC v. ICON Health & Fitness, Inc.*, 572 U.S. 545, 554 (2014). Such considerations are relevant to whether a case is deemed "exceptional" for purposes of awarding attorneys' fees. 35

U.S.C. § 285; *see, e.g.*, *WPEM, LLC v. SOTI Inc.*, 2020 WL 555545, at *7 (E.D. Tex. Feb. 4, 2020), *aff'd*, 837 F. App'x 773 (Fed. Cir. 2020) (awarding fees for an exceptional case where plaintiff "failed to conduct an invalidity and enforceability pre-filing investigation"); *Energy Heating, LLC v. Heat On-The-Fly, LLC*, 15 F.4th 1378, 1383 (Fed. Cir. 2021) (affirming award of fees where, *inter alia*, the plaintiff knew "that its patent was invalid").

A sample claim chart comparing claim 31 of *Neo Wireless* to *Sony* and *BlackBerry* is provided below.

US8456365 ("*Fractus*")	**A. US7319432** ("*Sony*") **B. US6466170** ("*BlackBerry*")
31.pre. **A mobile communication device**, comprising:	**A. US7319432** "The present description refers to **radio terminals as a device** in which to implement a radio antenna design according to the present invention. **The term radio terminal includes all mobile equipment devised for radio communication with a radio station, which radio station also may be mobile terminal** or e.g. a stationary base station. Consequently, **the term radio terminal includes mobile telephones, pagers, communicators, electronic organizers, smartphones, PDA:s (Personal Digital Assistants), vehicle-mounted radio communication devices, or the like, as well as portable laptop computers devised for wireless communication in e.g. a WLAN (Wireless Local Area Network)**." *Sony* at col. 6:4-15 **B. US6466170** "FIG. 1 is a multi-band antenna for use in **mobile communication devices**, and is particularly suitable for applications requiring a small form factor, **for example cellular telephones and other wireless enabled mobile communication devices**." *BlackBerry* at col. 2:45-49
31.a. **a device housing**;	**A. US7319432** "According to a second aspect, the object of the invention is fulfilled by **a communication terminal devised for multi-band radio communication, comprising a housing**, a user input and output interface, and in said housing a built-in antenna device including a flat ground substrate, a flat main radiating element having a radio signal feeding point, and a flat parasitic element." *Sony* at col. 4:34-40 **B. US6466170** "**The present inventions relate** generally to antenna devices, and more particularly **to internal multi-band slot antennas for mobile communication devices** and other compact antenna applications." *BlackBerry* at col. 1:6-9 "Dual band antennas are used widely in **mobile telephones** to accommodate different communication standards. Known external dual band antennas, also referred to as stubby antennas, however, tend to exhibit a high Specific Absorption Rate (SAR) compared to other conventional antennas. Additionally, **external and retractable antennas are exposed**

(cont.) 31.a. **a device housing**;	**outside the telephone housing, which is inconvenient for the user. Internal antennas have been proposed to replace external and retractable antennas**, but conventional internal antenna designs have do not provide adequate bandwidth, especially for dual mode applications." *BlackBerry* at col. 1:12-22  FIG. 6
31.b. **a printed circuit board**, the printed circuit board comprising:	**A. US7319432** "In one embodiment, the features of which are equally applicable to any of the previously mentioned aspects, said ground substrate is formed on one layer of **a printed circuit board**, whereas said main radiating element and said parasitic element are formed on another layer on said printed circuit board." *Sony* at col. 5:27-32 **B. US6466170** "FIG. 1 illustrates an internal multi-band antenna comprising generally a substantially planar radiating element 12 and a substantially planar ground conductor 14 disposed substantially parallel to the radiating element 12 to serve as a ground plane. In one embodiment, the ground conductor 14 is a conductive material disposed on a portion of **a printed circuit board** 32." *BlackBerry* at col. 2:59-65

31.c. **a ground plane layer**;	**A. US7319432** "In one embodiment, the features of which are equally applicable to any of the previously mentioned aspects, said **ground substrate is formed on one layer of a printed circuit board**, whereas said main radiating element and said parasitic element are formed on another layer on said printed circuit board." *Sony* at col. 5:27-32 **B. US6466170** "FIG. 1 illustrates an internal multi-band antenna comprising generally a substantially planar radiating element 12 and **a substantially planar ground conductor** 14 disposed substantially parallel to the radiating element 12 **to serve as a ground plane**. In one embodiment, **the ground conductor** 14 **is a conductive material disposed on a portion of a printed circuit board** 32." *BlackBerry* at col. 2:59-65
31.d. **a feeding point**;	**A. US7319432** "According to a first aspect, this object is fulfilled by a multi-band radio antenna device for a radio communication terminal, comprising a flat ground substrate, **a flat main radiating element having a radio signal feeding point**, and a flat parasitic element." *Sony* at col. 4:1-5 "Furthermore, **the feeding point** 3 (see FIG. 2) **may be a direct contact between the main radiating element** 2 **and the relevant leads on the PCB** 41, wherein no auxiliary antenna connector is needed. In one embodiment, the integrated multi-band radio antenna 12 and ground substrate 20 is etched out from a metal layer on a printed circuit board 41, including the ground substrate, the main radiating element and the parasitic element." *Sony* at col. 8:52-59 **B. US6466170** "In FIG. 1, **the feed point comprises a feeding strap** 18 **having one end coupled to the radiating element** 12. **Another portion or end** 19 **of the feeding strap** 18 **is coupled to electrical circuitry by a conductive lead**, not illustrated in the drawing. IN the exemplary embodiment, **the end** 19 **is the feed point**. The feeding strap 18 is not connected to the ground conductor. In the exemplary embodiment of FIG. 1, **there is a non-conductive area** 31 **on the printed circuit board where the feeding strap contacts the circuit board** 32. **The conductive lead coupled to the feed point may for example be disposed in a layer of the printed circuit board below the ground conductor**." *BlackBerry* at col. 3:18-29

31.e. **a communication circuitry, the communication circuitry being mounted on the printed circuit board**;	**A. US7319432** "**The radio communication terminal** 30 **includes radio transmission and reception electronics** (not shown), **and is devised with a built-in antenna device** 1 **inside the housing** 35, which antenna device is indicated in the drawing by the dashed line as an essentially flat object." *Sony* at col. 8:6-10 "According to a first aspect, this object is fulfilled by **a multi-band radio antenna device for a radio communication terminal, comprising** a flat ground substrate, **a flat main radiating element having a radio signal feeding point**, and a flat parasitic element." *Sony* at col. 4:1-5 "Hence, according to this aspect FIG. 4 illustrates **an integrated multi-band radio antenna** and ground substrate device 40 **for a radio communication terminal. This integrated device** 40 **comprises** a flat ground substrate 20, **a flat main radiating element** 2,9 **having a radio signal feeding point** 3, and a flat parasitic element 5,6, wherein said main radiating element is dielectrically separated from the ground substrate, and located adjacent to and in the same plane as said ground substrate. **The elements** 2,9,5,6,20 **comprised in the integrated device** 40 **are bonded by an underlying dielectric substrate** 41, **such as a PCB, wherein said PCB** 41 **preferably carries radio terminal electronics on its opposite side and optionally on intermediate layers thereof**." *Sony* at col. 8:31-44 "Furthermore, **the feeding point** 3 (see FIG. 2) **may be a direct contact between the main radiating element** 2 **and the relevant leads on the PCB** 41, wherein no auxiliary antenna connector is needed. In one embodiment, **the integrated multi-band radio antenna** 12 and ground substrate 20 **is etched out from a metal layer on a printed circuit board** 41, including the ground substrate, the main radiating element and the parasitic element." *Sony* at col. 8:52-59 "11. **A communication terminal devised for multi-band radio communication** comprising;" *Sony* at claim 11 **B. US6466170** "FIG. 1 is **a multi-band antenna for use in mobile communication devices**, and is particularly suitable for applications requiring a small form factor, for example cellular telephones and other wireless enabled mobile communication

(cont.) 31.e. **a communication circuitry, the communication circuitry being mounted on the printed circuit board**;	devices." *BlackBerry* at col. 2:45-49 "FIG. 1 illustrates **an internal multi-band antenna comprising generally a substantially planar radiating element** 12 **and a substantially planar ground conductor** 14 **disposed substantially parallel to the radiating element** 12 **to serve as a ground plane**. In one embodiment, **the ground conductor** 14 **is a conductive material disposed on a portion of a printed circuit board** 32." *BlackBerry* at col. 2:59-65 "In FIG. 1, **the feed point comprises a feeding strap** 18 **having one end coupled to the radiating element** 12. **Another portion or end** 19 **of the feeding strap** 18 **is coupled to electrical circuitry by a conductive lead**, not illustrated in the drawing. IN the exemplary embodiment, **the end** 19 **is the feed point**. The feeding strap 18 is not connected to the ground conductor. In the exemplary embodiment of FIG. 1, **there is a non-conductive area** 31 **on the printed circuit board where the feeding strap contacts the circuit board** 32. **The conductive lead coupled to the feed point may for example be disposed in a layer of the printed circuit board below the ground conductor**." *BlackBerry* at col. 3:18-29
31.f. **wherein the communication circuitry is coupled to the feeding point and to the ground plane layer**;	**A. US7319432** "**The radio communication terminal** 30 **includes radio transmission and reception electronics** (not shown), **and is devised with a built-in antenna device** 1 **inside the housing** 35, which antenna device is indicated in the drawing by the dashed line as an essentially flat object." *Sony* at col. 8:6-10 "According to a first aspect, this object is fulfilled by **a multi-band radio antenna device for a radio communication terminal, comprising a flat ground substrate, a flat main radiating element having a radio signal feeding point**, and a flat parasitic element." *Sony* at col. 4:1-5 "Hence, according to this aspect FIG. 4 illustrates **an integrated multi-band radio antenna and ground substrate device** 40 **for a radio communication terminal. This integrated device** 40 **comprises a flat ground substrate** 20, **a flat main radiating element** 2,9 **having a radio signal feeding point** 3, and a flat parasitic element 5,6, **wherein said main radiating element is dielectrically separated from the ground substrate, and located adjacent to and in the same plane as said ground substrate. The elements** 2,9,5,6,20 **comprised in the integrated device** 40 **are bonded by an**

(cont.) 31.f. **wherein the communication circuitry is coupled to the feeding point and to the ground plane layer**;	**underlying dielectric substrate** 41, **such as a PCB, wherein said PCB** 41 **preferably carries radio terminal electronics on its opposite side and optionally on intermediate layers thereof**." *Sony* at col. 8:31-44 "Furthermore, **the feeding point** 3 (see FIG. 2) **may be a direct contact between the main radiating element** 2 **and the relevant leads on the PCB** 41, wherein no auxiliary antenna connector is needed. In one embodiment, **the integrated multi-band radio antenna** 12 **and ground substrate** 20 **is etched out from a metal layer on a printed circuit board** 41, **including the ground substrate**, the main radiating element and the parasitic element." *Sony* at col. 8:52-59 "11. **A communication terminal devised for multi-band radio communication** comprising;" *Sony* at claim 11 **B. US6466170** "FIG. 1 is **a multi-band antenna for use in mobile communication devices**, and is particularly suitable for applications requiring a small form factor, for example cellular telephones and other wireless enabled mobile communication devices." *BlackBerry* at col. 2:45-49 "FIG. 1 illustrates **an internal multi-band antenna comprising generally a substantially planar radiating element** 12 **and a substantially planar ground conductor** 14 **disposed substantially parallel to the radiating element** 12 **to serve as a ground plane**. In one embodiment, **the ground conductor** 14 **is a conductive material disposed on a portion of a printed circuit board** 32." *BlackBerry* at col. 2:59-65 "In FIG. 1, **the feed point comprises a feeding strap** 18 **having one end coupled to the radiating element** 12. **Another portion or end** 19 **of the feeding strap** 18 **is coupled to electrical circuitry by a conductive lead**, not illustrated in the drawing. IN the exemplary embodiment, **the end** 19 **is the feed point**. The feeding strap 18 is not connected to the ground conductor. In the exemplary embodiment of FIG. 1, **there is a non-conductive area** 31 **on the printed circuit board where the feeding strap contacts the circuit board** 32. **The conductive lead coupled to the feed point may for example be disposed in a layer of the printed circuit board below the ground conductor**." *BlackBerry* at col. 3:18-29

31.g. **a multi-band antenna capable of operating at multiple frequency bands**, the multi-band antenna including:	**A. US7319432** "According to a first aspect, this object is fulfilled by **a multi-band radio antenna device** for a radio communication terminal, comprising a flat ground substrate, a flat main radiating element having a radio signal feeding point, and a flat parasitic element." *Sony* at col. 4:1-5 "Several effects and advantages are obtained by the invention. As evidenced by the graphs of FIGS. 6A and 6B, **a multi-band performance in frequency point of view is reached, suitable for e.g. AMPS, EGSM, DCSS, PCS, UMTS and BT**." *Sony* at col. 10:4-8 **B. US6466170** "In one embodiment, **the multi-band antennas described herein accommodate two or more distinct frequency bands of operation with a single excitation port. The multi-band antenna devices** employ shorting straps and a slot to generate multi-band band frequencies with a size and weight much smaller than conventional antennas. An exemplary embodiment described herein **generates GSM 900 MHZ frequency and DCS 1800 MHZ frequency**, as discussed more fully below." *BlackBerry* at col. 2:50-58 "For example, **the same internal antenna could be used for dual band AMPS (800 MHz) and PCS (1900 MHz) in North America, or dual band GSM (900 MHz) and DCS (1800 MHz), or tri-band GSM, DCS, PCS, or quad-band AMPS, GSM, DCS, PCS**." *BlackBerry* at col. 4:56-60
31.h. **a dielectric mounting structure having a plurality of surfaces**;	**A. US7319432** "Hence, according to this aspect FIG. 4 illustrates an integrated multi-band radio antenna and ground substrate device 40 for a radio communication terminal. This integrated device 40 comprises a flat ground substrate 20, a flat main radiating element 2,9 having a radio signal feeding point 3, and a flat parasitic element 5,6, wherein said **main radiating element is dielectrically separated from the ground substrate**, and located adjacent to and in the same plane as said ground substrate. **The elements** 2,9,5,6,20 **comprised in the integrated device** 40 **are bonded by an underlying dielectric substrate** 41, **such as a PCB, wherein said PCB** 41 **preferably carries radio terminal electronics on its opposite side and optionally on intermediate layers thereof**." *Sony* at col. 8:31-44

(cont.) 31.h. **a dielectric mounting structure having a plurality of surfaces**;	**B. US6466170** "FIG. 1 illustrates **an internal multi-band antenna comprising generally a substantially planar radiating element** 12 **and a substantially planar ground conductor** 14 **disposed substantially parallel to the radiating element** 12 **to serve as a ground plane**. In one embodiment, **the ground conductor** 14 **is a conductive material disposed on a portion of a printed circuit board** 32." *BlackBerry* at col. 2:59-65 "**A dielectric** 16 **is disposed between the radiating element and the ground conductor**. In FIG. 1, the exemplary dielectric 16 is an air gap. Alternatively, **the dielectric may be some other material, formed for example as a substrate, between the radiating element and the ground conductor. Where the dielectric** 16 **is** an air gap, **plastic supports or some other offsets** 34 **may position the radiating element** 12 **relative to the ground conductor** 14 **or the printed circuit board** 32." *BlackBerry* at col. 2:66-67 through col. 3:1-7
31.i. **an antenna element**, the antenna element being **coupled to the feeding point and operating in cooperation with the ground plane layer**;	**A. US7319432** "**The main radiating element of the antenna comprises a first flat elongated member** 2, **which extends from a position** 4 **close to the upper edge** 21 **of ground plane** 20. In the preferred and disclosed embodiment, this elongated member is bent 90 degrees in order to make the total length of the antenna device 1, including the ground plane 20, as short as possible. **The main radiating element is fed at a feeding point** 3 **at or near its base** 4, **adjacent to the edge** 21 **of the ground plane** 20, **but it is dielectrically separated from the ground plane** 20, e.g. by a gap." *Sony* at col. 7:20-29 "Hence, according to this aspect FIG. 4 illustrates **an integrated multi-band radio antenna and ground substrate device** 40 **for a radio communication terminal. This integrated device** 40 **comprises a flat ground substrate** 20, **a flat main radiating element** 2,9 **having a radio signal feeding point** 3, **and a flat parasitic element** 5,6, **wherein said main radiating element is dielectrically separated from the ground substrate, and located adjacent to and in the same plane as said ground substrate**. The elements 2,9,5,6,20 comprised in the integrated device 40 are bonded by an underlying dielectric substrate 41, such as a PCB, wherein said PCB 41 preferably carries radio terminal electronics on its opposite side and optionally on intermediate layers thereof." *Sony* at col. 8:31-44

(cont.) 31.i. **an antenna element**, the antenna element being **coupled to the feeding point and operating in cooperation with the ground plane layer**;	**B. US6466170** "FIG. 1 illustrates **an internal multi-band antenna comprising generally a substantially planar radiating element** 12 **and a substantially planar ground conductor** 14 **disposed substantially parallel to the radiating element** 12 **to serve as a ground plane**. In one embodiment, **the ground conductor** 14 **is a conductive material disposed on a portion of a printed circuit board** 32." *BlackBerry* at col. 2:59-65 "In FIG. 1, **the feed point comprises a feeding strap** 18 **having one end coupled to the radiating element** 12. **Another portion or end** 19 **of the feeding strap** 18 **is coupled to electrical circuitry by a conductive lead**, not illustrated in the drawing. IN the exemplary embodiment, **the end** 19 **is the feed point**. The feeding strap 18 is not connected to the ground conductor. In the exemplary embodiment of FIG. 1, **there is a non-conductive area** 31 **on the printed circuit board where the feeding strap contacts the circuit board** 32. **The conductive lead coupled to the feed point may for example be disposed in a layer of the printed circuit board below the ground conductor**." *BlackBerry* at col. 3:18-29 "**Multi-mode operation is provided by selectively connecting one or more of a plurality of shorting straps between the radiating element and the ground conductor, thereby tuning the input impedance of the antenna**, as discussed more fully below." *BlackBerry* at col. 3:59-63 "14. **An antenna device, comprising**: **a planar radiating element**; **a radiating element ground plane conductor disposed substantially parallel with the radiating element**; . . . **a feeding strap coupled to the radiating element**;" *BlackBerry* at claim 14
31.j. **wherein the antenna element comprises a first radiating arm arranged on two or more surfaces of the plurality of surfaces of the dielectric mounting structure**;	**A. US7319432** "Hence, according to this aspect FIG. 4 illustrates **an integrated multi-band radio antenna and ground substrate device** 40 **for a radio communication terminal. This integrated device** 40 **comprises a flat ground substrate** 20, **a flat main radiating element** 2,9 **having a radio signal feeding point** 3, **and a flat parasitic element** 5,6, **wherein said main radiating element is dielectrically separated from the ground substrate, and located adjacent to and in the same plane as said ground substrate. The elements**

(cont.)
31.j. **wherein the antenna element comprises a first radiating arm arranged on two or more surfaces of the plurality of surfaces of the dielectric mounting structure**;

2,9,5,6,20 **comprised in the integrated device** 40 **are bonded by an underlying dielectric substrate** 41, **such as a PCB, wherein said PCB** 41 **preferably carries radio terminal electronics on its opposite side and optionally on intermediate layers thereof**." *Sony* at col. 8:31-44

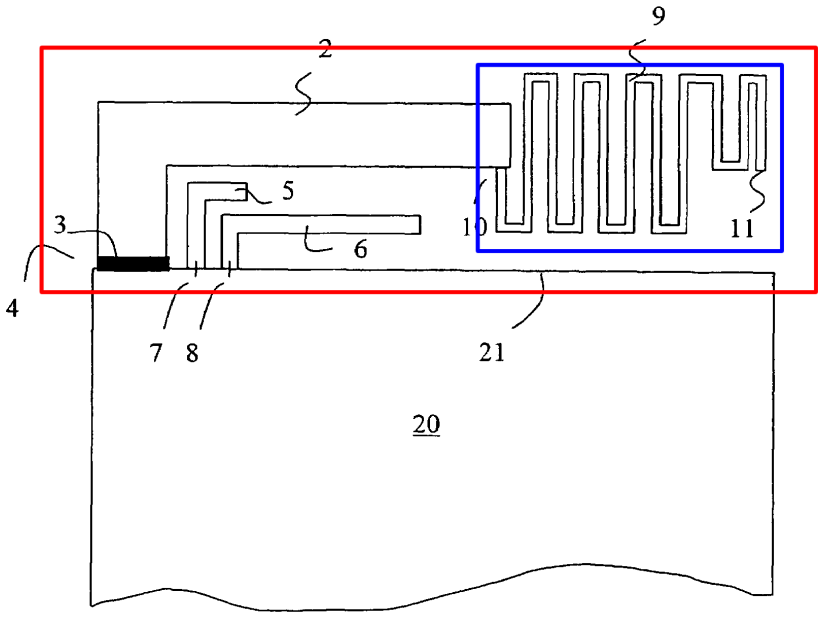


Fig. 2

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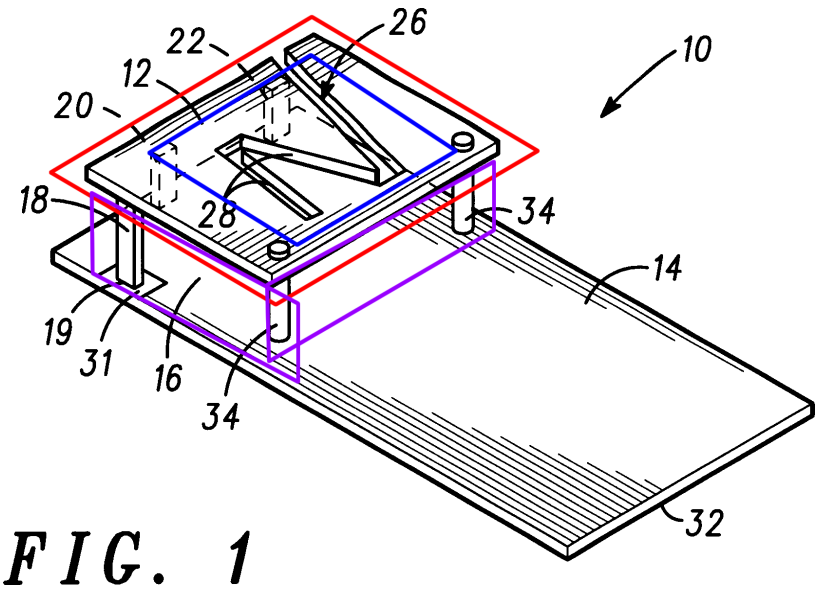
"FIG. 1 illustrates **an internal multi-band antenna comprising generally a substantially planar radiating element** 12 **and a substantially planar ground conductor** 14 **disposed substantially parallel to the radiating element** 12 **to serve as a ground plane**. In one embodiment, **the ground conductor** 14 **is a conductive material disposed on a portion of a printed circuit board** 32." *BlackBerry* at col. 2:59-65

"**A dielectric** 16 **is disposed between the radiating element and the ground conductor**. In FIG. 1, the exemplary dielectric 16 is an air gap. Alternatively, **the dielectric may be some other material, formed for example as a substrate, between the radiating element and the ground conductor. Where the dielectric** 16 **is** an air gap, **plastic supports or some other offsets** 34 **may position the radiating element** 12 **relative to the ground conductor** 14 **or the printed circuit board** 32." *BlackBerry* at col. 2:66-67 through col. 3:1-7

"In FIG. 1, **an angled slot** 26 **is disposed on the radiating element** 12. **The angled slot is partitioned into at least two**

(cont.) 31.j. **wherein the antenna element comprises a first radiating arm arranged on two or more surfaces of the plurality of surfaces of the dielectric mounting structure**;	**segments or sections** 28 **preferably arranged at acute angles relative to one another**. Preferably, the angled slot is partitioned into at least three slot sections 28. **Exemplary angled slot configurations include forms with a Z or N or M or W shape or other acute angle shapes or combinations thereof**. FIG. 2 illustrates another acute angled slot having a W-shaped configuration." *BlackBerry* at col. 3:36-44  FIG. 1 "1. **An antenna device, comprising**: **a substantially planar radiating element**; **a substantially planar ground conductor disposed adjacent the radiating element**; **a dielectric disposed between the radiating element and the ground conductor**; . . . **an acute angled slot formed in the radiating element, the acute angled slot having at least three slot sections, each slot section arranged at an acute angle relative to at least one other slot section**." *BlackBerry* at claim 1
31.k. **the first radiating arm comprising**: 31.l. **a first section shaped according to a grid-dimension curve**;	**A. US7319432** "The total length of the wide elongated member 2 is about 35 mm from 4 to 10. At this end 10, **the main radiating element extends into a considerably longer, meandered member** 9, **which has a significantly smaller width than member** 2." *Sony* at col. 7:32-36 "1. A multi-band radio antenna device for a radio communication terminal comprising: . . .

(cont.)
31.k. **the first radiating arm comprising**:

31.l. **a first section shaped according to a grid-dimension curve**;

wherein **a first elongated portion of the flat main radiating element extends in an L shape away from a side edge of the flat ground substrate, a longer leg of the L shape extending substantially parallel to the side edge**." *Sony* at claim 1

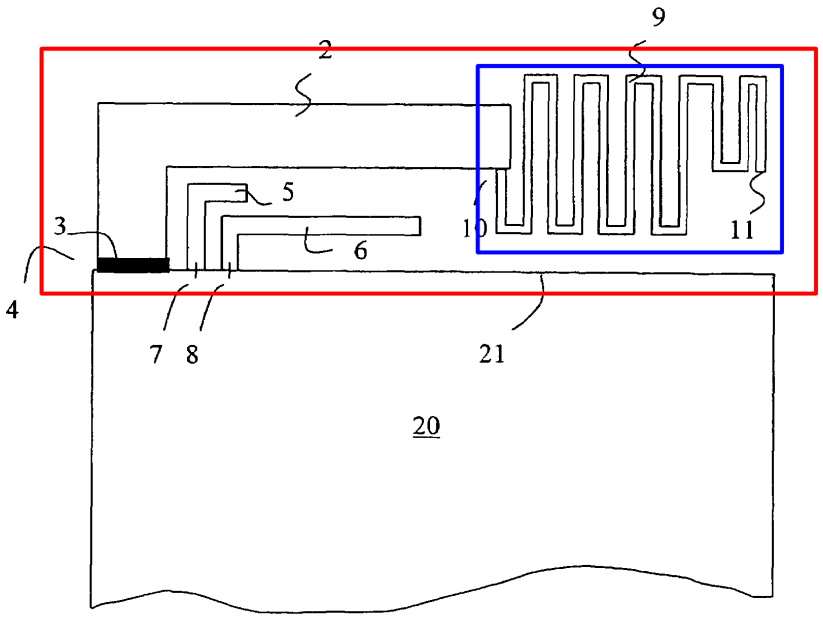


Fig. 2

"4. The multi-band radio antenna device of claim 2, wherein **the second elongated portion is meandered**." *Sony* at claim 4

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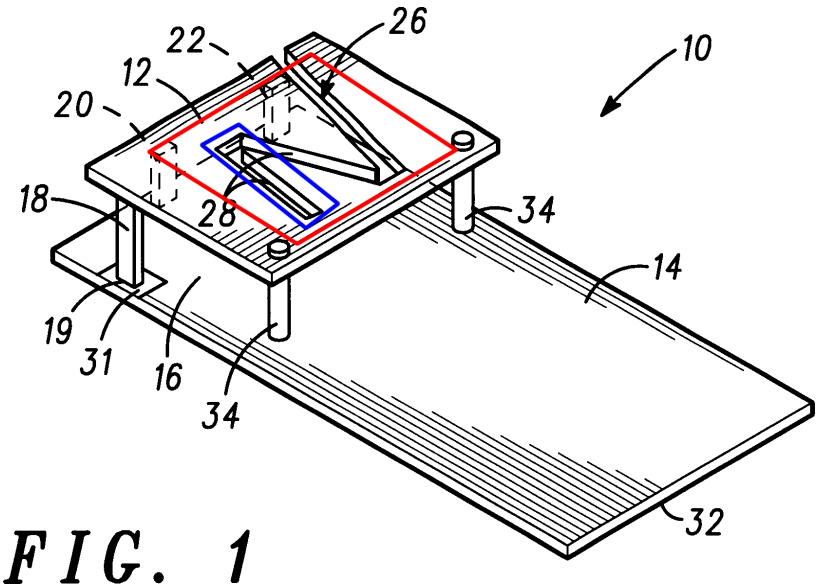
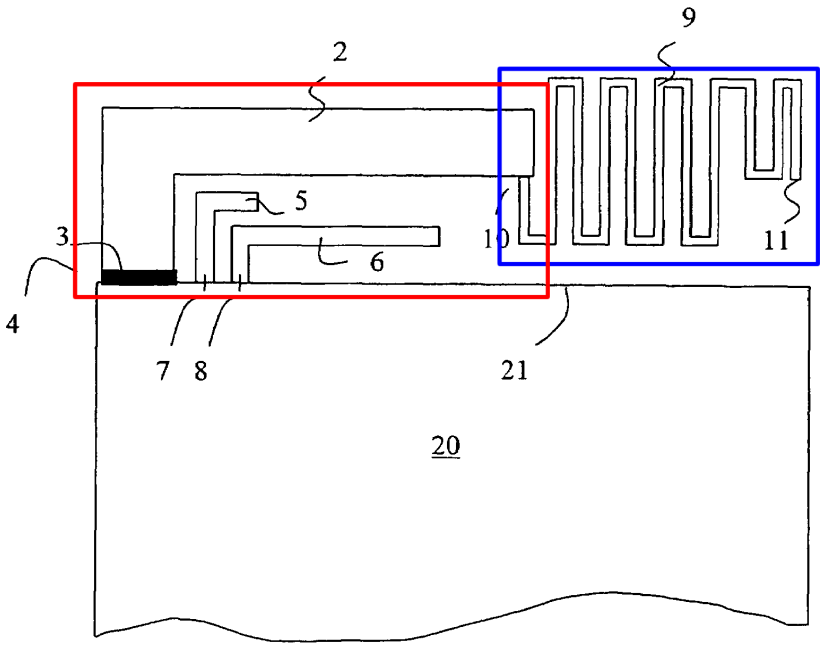
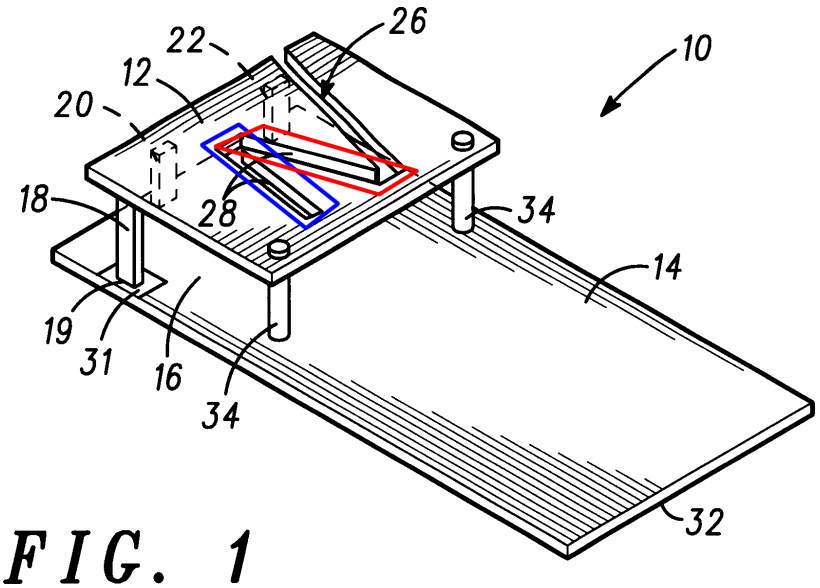


FIG. 1

(cont.) 31.k. **the first radiating arm comprising**: 31.l. **a first section shaped according to a grid-dimension curve**;	"In FIG. 1, **an angled slot** 26 **is disposed on the radiating element** 12. **The angled slot is partitioned into at least two segments or sections** 28 **preferably arranged at acute angles relative to one another**. Preferably, the angled slot is partitioned into at least three slot sections 28. **Exemplary angled slot configurations include forms with a Z or N or M or W shape or other acute angle shapes or combinations thereof**. FIG. 2 illustrates another acute angled slot having a W-shaped configuration." *BlackBerry* at col. 3:36-44
31.m. **a second section connected to the grid-dimension section, the second section having a width different from a width of the first section**; and	**A. US7319432** "**The main radiating element of the antenna comprises a first flat elongated member** 2, **which extends from a position** 4 **close to the upper edge** 21 **of ground plane** 20. In the preferred and disclosed embodiment, **this elongated member is bent 90 degrees** in order to make the total length of the antenna device 1, including the ground plane 20, as short as possible. The main radiating element is fed at a feeding point 3 at or near its base 4, adjacent to the edge 21 of the ground plane 20, but it is dielectrically separated from the ground plane 20, e.g. by a gap." *Sony* at col. 7:20-29  Fig. 2 "**The total length of the wide elongated member** 2 **is about 35 mm from** 4 **to** 10. **At this end** 10, **the main radiating element extends into a considerably longer, meandered member** 9, **which has a significantly smaller width than member** 2. The barrier obtained by the bottleneck at 10 creates

(cont.) 31.m. **a second section connected to the grid-dimension section, the second section having a width different from a width of the first section**; and	one resonance dependent on the length of the wide member 2, and another resonance dependent on the entire length of the main radiating element 2,9 from end 4 at the feeding point 3 to the end point 11. **The relation between the width of member 2 and member 9 is at least 5:1, and preferably about 10:1**. This relation is hence important in order to get the multi-band performance. At the end 11 of the meandered portion 9, yet another radiating element may be added, electrically interconnected to portion 9, although not shown, a so called capacitive end piece." *Sony* at col. 7:32-47 "1. A multi-band radio antenna device for a radio communication terminal comprising: . . . wherein **a first elongated portion of the flat main radiating element extends in an L shape away from a side edge of the flat ground substrate, a longer leg of the L shape extending substantially parallel to the side edge**." *Sony* at claim 1 "2. The multi-band radio antenna device of claim 1, wherein **the first elongated portion has a first width, and extends into a second elongated portion having a second width, the second width being smaller than the first width**." *Sony* at claim 2 **B. US6466170**  FIG. 1 "In FIG. 1, **an angled slot** 26 **is disposed on the radiating element** 12. **The angled slot is partitioned into at least two segments or sections** 28 **preferably arranged at acute angles**

(cont.) 31.m. **a second section connected to the grid-dimension section, the second section having a width different from a width of the first section**; and	**relative to one another**. Preferably, the angled slot is partitioned into at least three slot sections 28. **Exemplary angled slot configurations include forms with a Z or N or M or W shape or other acute angle shapes or combinations thereof**. FIG. 2 illustrates another acute angled slot having a W-shaped configuration." *BlackBerry* at col. 3:36-44
31.n. **wherein the printed circuit board, the communication circuitry, and the multi-band antenna are arranged inside the device housing**.	**A. US7319432** "According to a first aspect, this object is fulfilled by **a multi-band radio antenna device for a radio communication terminal, comprising a flat ground substrate, a flat main radiating element having a radio signal feeding point, and a flat parasitic element**." *Sony* at col. 4:1-5 "According to a second aspect, the object of the invention is fulfilled by **a communication terminal devised for multi-band radio communication, comprising a housing**, a user input and output interface, **and in said housing a built-in antenna device including a flat ground substrate, a flat main radiating element having a radio signal feeding point, and a flat parasitic element**." *Sony* at col. 4:34-40 "**The radio communication terminal** 30 **includes radio transmission and reception electronics** (not shown), **and is devised with a built-in antenna device** 1 **inside the housing** 35, which antenna device is indicated in the drawing by the dashed line as an essentially flat object." *Sony* at col. 8:6-10 "Hence, according to this aspect FIG. 4 illustrates **an integrated multi-band radio antenna and ground substrate device** 40 **for a radio communication terminal. This integrated device** 40 **comprises a flat ground substrate** 20, **a flat main radiating element** 2,9 **having a radio signal feeding point** 3, **and a flat parasitic element** 5,6, **wherein said main radiating element is dielectrically separated from the ground substrate, and located adjacent to and in the same plane as said ground substrate. The elements** 2,9,5,6,20 **comprised in the integrated device** 40 **are bonded by an underlying dielectric substrate** 41, **such as a PCB, wherein said PCB** 41 **preferably carries radio terminal electronics on its opposite side and optionally on intermediate layers thereof**." *Sony* at col. 8:31-44 "Furthermore, **the feeding point** 3 (see FIG. 2) **may be a direct contact between the main radiating element** 2 **and the relevant leads on the PCB** 41, wherein no auxiliary

(cont.) 31.n. **wherein the printed circuit board, the communication circuitry, and the multi-band antenna are arranged inside the device housing**.	antenna connector is needed. In one embodiment, **the integrated multi-band radio antenna** 12 **and ground substrate** 20 **is etched out from a metal layer on a printed circuit board** 41, **including the ground substrate**, the main radiating element and the parasitic element." *Sony* at col. 8:52-59 "11. **A communication terminal devised for multi-band radio communication** comprising;" *Sony* at claim 11 **B. US6466170** "Dual band antennas are used widely in **mobile telephones** to accommodate different communication standards. Known external dual band antennas, also referred to as stubby antennas, however, tend to exhibit a high Specific Absorption Rate (SAR) compared to other conventional antennas. Additionally, **external and retractable antennas are exposed outside the telephone housing, which is inconvenient for the user. Internal antennas have been proposed to replace external and retractable antennas**, but conventional internal antenna designs have do not provide adequate bandwidth, especially for dual mode applications." *BlackBerry* at col. 1:12-22 "FIG. 1 illustrates **an internal multi-band antenna comprising generally a substantially planar radiating element** 12 **and a substantially planar ground conductor** 14 **disposed substantially parallel to the radiating element** 12 **to serve as a ground plane**. In one embodiment, **the ground conductor** 14 **is a conductive material disposed on a portion of a printed circuit board** 32." *BlackBerry* at col. 2:59-65 "In FIG. 1, **the feed point comprises a feeding strap** 18 **having one end coupled to the radiating element** 12. **Another portion or end** 19 **of the feeding strap** 18 **is coupled to electrical circuitry by a conductive lead**, not illustrated in the drawing. IN the exemplary embodiment, **the end** 19 **is the feed point**. The feeding strap 18 is not connected to the ground conductor. In the exemplary embodiment of FIG. 1, **there is a non-conductive area** 31 **on the printed circuit board where the feeding strap contacts the circuit board** 32. **The conductive lead coupled to the feed point may for example be disposed in a layer of the printed circuit board below the ground conductor**." *BlackBerry* at col. 3:18-29