CONFORMAL PHASED ARRAY ANTENNA WITH INTEGRATED TRANSCEIVER

Inventors: Helen K. Pan, Saratoga, CA (US); Mark Ruberto, Haifa (IL); Bryce D. Horine, Portland, OR (US); Shmuel Ravid, Haifa (IL)

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ABSTRACT

A system according to one embodiment includes a plurality of antennas configured on a conformal material, the conformal material capable of conforming to a contour of a platform; and driver circuitry coupled to each of the plurality of antennas, wherein the driver circuitry comprises a plurality of transceivers, the plurality of transceivers configured to provide independently adjustable phase delay in the coupling to each of the plurality of antennas.
Configuring a plurality of antennas on a conformal material, the conformal material capable of conforming to a contour of a platform

Coupling driver circuitry to each of the plurality of antennas, wherein the driver circuitry comprises a plurality of transceivers

Configuring the plurality of transceivers to provide independently adjustable phase delay to each of the plurality of antennas

FIG. 7
CONFORMAL PHASED ARRAY ANTENNA WITH INTEGRATED TRANSCIEVER

FIELD

[0001] The present disclosure relates to phased array antennas, and more particularly, to conformal phased array antennas with integrated transceivers.

BACKGROUND

[0002] Electronic devices, such as laptops, notebooks, netbooks, personal digital assistants (PDAs) and mobile phones, for example, increasingly tend to include a variety of wireless communication capabilities. The wireless communication systems used by these devices are expanding into the higher frequency ranges of the communication spectrum, such as, for example, the millimeter wave region and, in particular, the 60 GHz band. Propagation losses and attenuation tend to increase at these higher frequencies, however, and it can become difficult to implement antenna systems on the device platform in a manner that provides the desired spatial coverage, for example, omni-directional or nearly omni-directional coverage.

[0003] Existing approaches to solve this problem generally rely on the deployment of multiple active antenna modules on various sides of the device to increase spatial coverage. This approach, however, increases cost and power consumption and becomes increasingly impractical as platform sizes shrink or take on unusual form factors with a variety of surface contours and angles.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] Features and advantages of embodiments of the claimed subject matter will become apparent as the following Detailed Description proceeds, and upon reference to the Drawings, wherein like numerals depict like parts, and in which:

[0005] FIG. 1 illustrates a system diagram of one exemplary embodiment consistent with the present disclosure;

[0006] FIG. 2 illustrates a system diagram of another exemplary embodiment consistent with the present disclosure;

[0007] FIG. 3 illustrates a system diagram of another exemplary embodiment consistent with the present disclosure;

[0008] FIG. 4 illustrates a cross sectional view of one exemplary embodiment consistent with the present disclosure;

[0009] FIG. 5 illustrates a circuit diagram of one exemplary embodiment consistent with the present disclosure;

[0010] FIG. 6 illustrates a block diagram of one exemplary embodiment consistent with the present disclosure; and

[0011] FIG. 7 illustrates a flowchart of operations of one exemplary embodiment consistent with the present disclosure.

[0012] Although the following Detailed Description will proceed with reference being made to illustrative embodiments, many alternatives, modifications, and variations thereof will be apparent to those skilled in the art.

DETAILED DESCRIPTION

[0013] Generally, this disclosure provides systems and methods for achieving increased spatial coverage of wireless communications by deploying conformal phased array antennas, with integrated transceivers, on a platform. The antenna elements may be disposed on a flexible substrate capable of conforming to the contours of the platform, allowing the antenna elements to be deployed at suitable locations on the platform, for example the sides and top of the platform, to achieve multi-directional radio frequency (RF) spatial coverage. Additionally, some or all of the antenna elements may be coupled to integrated transceivers with phase shifting capabilities that enable those antenna elements to form a phased array antenna (also referred to as an active antenna). The phased array antenna may perform beam scanning to further increase RF spatial coverage. In some embodiments, the transceivers and any additional RF circuitry may be included in a single RF integrated circuit (RFIC) and the RFIC may be integrated with the conformal phased array antennas to decrease power and space consumption. The system may be configured to operate in the millimeter wave (mm-wave) region of the RF spectrum and, in particular, the 60 GHz region in association with the use of wireless personal area network (WPAN) and wireless local area network (WLAN) communication systems.

[0014] The term Personal basic service set Control Point (PCP) as used herein, is defined as a station (STA) that operates as a control point of the mm-wave network.

[0015] The term access point (AP) as used herein, is defined as any entity that has STA functionality and provides access to the distribution services, via the wireless medium (WM) for associated STAs.

[0016] The term wireless network controller as used herein, is defined as a station that operates as a PCP and/or as an AP of the wireless network.

[0017] The term directional band (DBand) as used herein is defined as any frequency band wherein the Channel starting frequency is above 45 GHz.

[0018] The term DBand STA as used herein is defined as a STA whose radio transmitter is operating on a channel that is within the DBand.

[0019] The term personal basic service set (PBSS) as used herein is defined as a basic service set (BSS) which forms an ad hoc self-contained network, operates in the DBand, includes one PBSS control point (PCP), and in which access to a distribution system (DS) is not present but an intra-PBSS forwarding service is optionally present.

[0020] The term scheduled service period (SP) as used herein is scheduled by a quality of service (QoS) AP or a PCP. Scheduled SPs may start at fixed intervals of time, if desired.

[0021] The terms “traffic” and/or “traffic stream(s)” as used herein, are defined as a data flow and/or stream between wireless devices such as STAs. The term “session” as used herein is defined as state information kept or stored in a pair of stations that have an established a direct physical link (e.g., excludes forwarding); the state information may describe or define the session.

[0022] The term “wireless device” as used herein includes, for example, a device capable of wireless communication, a communication device capable of wireless communication, a communication station capable of wireless communication, a portable or non-portable device capable of wireless communication, or the like. In some embodiments, a wireless device may be or may include a peripheral device that is integrated with a computer, or a peripheral device that is attached to a computer. In some embodiments, the term “wireless device” may optionally include a wireless service.

[0023] It should be understood that the present invention may be used in a variety of applications. Although the present invention is not limited in this respect, the circuits and techniques disclosed herein may be used in many apparatuses...
such as stations of a radio system. Stations intended to be included within the scope of the present invention include, by way of example only, WLAN stations, wireless personal network (WPAN), and the like.

[0024] Types of WPAN stations intended to be within the scope of the present invention include, although are not limited to, stations capable of operating as a multi-band stations, stations capable of operating as an AP, stations capable of operating as DBand stations, mobile stations, access points, stations for receiving and transmitting spread spectrum signals such as, for example, Frequency Hopping Spread Spectrum (FHSS), Direct Sequence Spread Spectrum (DSSS), Complementary Code Keying (CCK), Orthogonal Frequency-Division Multiplexing (OFDM) and the like.

[0025] Some embodiments may be used in conjunction with various devices and systems, for example, a video device, an audio device, an audio-video (AV) device, a Set-Top-Box (STB), a Blu-ray disc (BD) player, a BD recorder, a Digital Video Disc (DVD) player, a High Definition (HD) DVD player, a DVD recorder, a HD DVD recorder, a Personal Video Recorder (PVR), a broadcast HD receiver, a video source, an audio source, a video sink, an audio sink, a stereo tuner, a broadcast radio receiver, a display, a flat panel display, a Personal Media Player (PMP), a digital video camera (DVC), a digital audio player, a speaker, an audio receiver, an audio amplifier, a data source, a data sink, a Digital Still camera (DSC), a Personal Computer (PC), a desktop computer, a notebook computer, a laptop computer, a tablet computer, a server computer, a handheld computer, a handheld device, a Personal Digital Assistant (PDA) device, a handheld PDA device, an on-board device, an off-board device, a hybrid device, a vehicular device, a non-vehicular device, a mobile or portable device, a consumer device, a non-mobile or non-portable device, a wireless communication station, a wireless communication device, a wireless AP, a wired or wireless router, a wired or wireless modem, a wired or wireless network, a wireless area network, a Wireless Video Are Network (WVAN), a Local Area Network (LAN), a WLAN, a PAN, a WPAN, devices and/or networks operating in accordance with existing WirelessHD™ and/or Wireless-Gigabit-Alliance (WGA) specifications and/or future versions and/or derivatives thereof, devices and/or networks operating in accordance with existing IEEE 802.11 (IEEE 802.11-2007: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications) standards and amendments ("the IEEE 802.11 standards"), IEEE 802.16 standards, and/or future versions and/or derivatives thereof, units and/or devices which are part of the above networks, one way and/or two-way radio communication systems, cellular radio-telephone communication systems, Wireless-Display (WiDi) device, a cellular telephone, a wireless telephone, a Personal Communication Systems (PCS) device, a PDA device which incorporates a wireless communication device, a mobile or portable Global Positioning System (GPS) device, a device which incorporates a GPS receiver or transceiver or chip, a device which incorporates an RFID element or chip, a Multiple Input Multiple Output (MIMO) transceiver or device, a Single Input Multiple Output (SIMO) transceiver or device, a Multiple Input Single Output (MISO) transceiver or device, a device having one or more internal antennas and/or external antennas, Digital Video Broadcast (DVB) devices or systems, multi-standard radio devices or systems, a wired or wireless handheld device (e.g., BlackBerry, Palm Treo), a Wireless Application Protocol (WAP) device, or the like.

[0026] Some embodiments may be used in conjunction with one or more types of wireless communication signals and/or systems, for example, Radio Frequency (RF), Infra Red (IR), Frequency-Division Multiplexing (FD), Orthogonal FDM (OFDM), Time-Division Multiplexing (TDM), Time-Division Multiple Access (TDMA), Extended TDMA (ETDMA), General Packet Radio Service (GPRS), extended GPRS, Code-Division Multiple Access (CDMA), Wideband CDMA (WCDMA), CDMA 2000, single-carrier CDMA, multi-carrier CDMA, Multi-Carrier Modulation (MDM), Discrete Multi-Tone (DMT), Bluetooth®, Global Positioning System (GPS), Wi-Fi, Wi-Max, ZigBee™, Ultra Wideband (UWB), Global System for Mobile communication (GSM), 2 G, 2.5 G, 3 G, 3.5 G, Enhanced Data rates for GSM Evolution (EDGE), and the like. Other embodiments may be used in various other devices, systems and/or networks.

[0027] Some embodiments may be used in conjunction with suitable limited-range or short-range wireless communication networks, for example, "piconets", e.g., a wireless area network, a WVAN, a WPAN, and the like.

[0028] FIG. 1 illustrates a system diagram 100 of one exemplary embodiment consistent with the present disclosure. Platform 102 is shown as a laptop computer in this illustrative embodiment, but it may be any device including a notebook, netbook, personal digital assistant (PDA), mobile phone, network hub or any device for which wireless communication capability may be desired. RFIC 104 is shown as being located near the center of the laptop lid 112, but it may be located at any suitable position including the base of the platform 102, for example, where space may be available, or closer to one of the upper corners of laptop lid 112 to reduce the distance to conformal antennas 106 and 108 or 106 and 110. RFIC 104 may be located at any other suitable location where manufacturing and/or design constraints permit. Conformal antennas 106, 108, 110 are shown as being ninety degrees around the edges of the right, top and left sides, respectively, of the laptop lid 112, although they may be located at any suitable position on the platform 102 and may be aligned to any bending angle and there may be any number of such antennas. The term "conformal" is used to indicate that the antenna has sufficient flexibility to allow it to generally follow the shape of at least one of the contours of the platform 102 when the antenna is dispose on the platform 102. The number of conformal antennas 106, 108, 110 and their placement may be chosen, for example, based on RF requirements such as spatial coverage including scan directions, antenna gain and bandwidth, as well as other design and/or manufacturing considerations. The conformal nature of antennas 106, 108, 110 increases the number of potential placement configurations available on platform 102; particularly in situations where platforms have multiple surfaces with varying angles. In some embodiments, conformal antennas 106, 108, 110 may be disposed on interior surfaces or portions of platform 102.

[0029] In a preferred embodiment, a single RFIC 104 may drive all conformal antennas 106, 108 and 110 as will be explained in greater detail below. The use of a single RFIC 104 may permit reduction in cost, power consumption and space consumption. The RFIC may be implemented in silicon...
complementary metal-oxide semiconductor (SiCMOS) technology or other suitable technologies. 

[0030] Conformal antennas 106, 108 and 110 may comprise antenna elements that are printed onto a substrate that has sufficient flexibility for the conformal antenna to conform to the contours of the platform 102. The substrate may be a single layer or multiple layers, which, in some embodiments, may be configured as a laminate structure. The layers may comprise a dielectric material with a low tangent loss, i.e., configured to reduce dissipation of electromagnetic energy associated with radio-frequency (RF) signal propagation and thus increase antenna performance. Examples of suitable materials for the layers include, but are not limited to, liquid crystal polymer (LCP) such as Ultralam 3000®, polyimide and Teflon.

[0031] FIG. 2 is a system diagram 200 of the embodiment shown in FIG. 1, further illustrating exemplary antenna beam patterns 206 and 210 associated with conformal antennas 106 and 110, as well as antenna beam patterns 208a, 208b, 208c associated with conformal antenna 108. In some embodiments, beam pattern 206 may be an omni-directional, or other fixed beam pattern directed to cover a spatial area on the right side of the platform 102 generated by a single antenna element in conformal antenna 106. Similarly, beam pattern 210 may be an omni-directional, or other fixed beam pattern directed to cover a spatial area on the left side of the platform 102 generated by a single antenna element in conformal antenna 110. In some embodiments, the single antenna elements in conformal antennas 106 and 110 may be high-gain antennas with increased directivity which may alleviate signal attenuation and/or interference cause by electronics in the platform. Examples of high-gain antennas include Taper Slot antennas, Yagi antennas and periodic antennas.

[0032] Beam patterns 208a, 208b, 208c may be generated by beam scanning of phased array antenna elements in conformal antenna 108 as will be explained in greater detail below. The scanned beams 208a, 208b, 208c may be directed to cover a spatial area over the top of the platform 102. Although only 3 beams 208a, 208b, 208c are shown for illustrative purposes, in practice, the phased array antenna may generate a beam that is scanned or steered through many more positions by incrementally adjusting the relative phases of the antenna elements to repeatedly sweep the beam through an arc of desired coverage.

[0033] Additional beams, not shown, may also be directed outward in other directions as needed. For example, antenna elements may be located on either or both sides of the ninety degree bends in the conformal antennas 106, 108, 110 to provide beams in substantially orthogonal directions. These example antenna configurations and beam patterns are provided for illustrative purposes. In practice, however, any suitable arrangement may be implemented.

[0034] FIG. 3 is a system diagram 300 showing another embodiment of a conformal antenna 312 and associated beam patterns 302, 308, 316 in greater detail. Conformal antenna 312 is shown to conform to the contours of an underlying platform (not shown) by bending along dotted lines 310, allowing conformal antenna 312 to be disposed along platform surfaces of varying orientation in all three dimensions, such as, for example, orthogonally oriented surfaces. Antenna elements 304, 306, 314 may be disposed on each of the surfaces of conformal antenna 312. Antenna element 304 may act as a single element antenna generating a fixed beam pattern 302 in a first direction. Antenna elements 306 are shown to be configured in a 1x5 phased array, as one possible example, to generate scanned beam patterns 308 in a second direction, which may be substantially orthogonal to the first direction. Similarly, antenna elements 314 are shown to be configured in a 2x8 phased array, as another possible example, to generate scanned beam patterns 316 in a third direction, which may be substantially orthogonal to the first and second directions. The number and placement of antenna elements in a given phased array may be chosen based on desired properties of the scanned beam patterns to be generated. For example, increasing the number of antenna elements may generally increase the gain of the antenna beam.

[0035] In some embodiments, the antenna elements that are configured in a phased array 306, 314 may comprise dummy antenna elements 318 at some or all of the edges of the phased array. The edge antenna elements 318 may generally be located at the end of the transmission line that couples the RFIC 104 to the antenna elements 306, 314. The dummy antenna elements 318 may be termination load resistors that reduce reflections of the RF signal at the end of the transmission line by providing termination impedance that is matched to the characteristic impedance of the transmission line. This may increase the stability of the frequency and bandwidth properties of the phased array as it scans the beam through different angles.

[0036] FIG. 4 illustrates a cross sectional view 400 of one exemplary embodiment consistent with the present disclosure. Shown, are RFIC 104, one of conformal antennas 106, 108, 110, Flexible substrate 412, signal routing layer 414 and antenna elements 314, 304, 306. RFIC 104 may be electrically coupled to signal routing layer 414 through flip-chip connection points 416. Flip-chip connections, which are also known as “controlled collapse chip connections,” are a method of connecting ICs to external circuitry with solder bumps that are deposited on chip pads located on the top side of the chip. During the connection process, the chip is flipped onto the external circuitry such that the top side of the chip faces down and the solder pads on the chip align with the solder pads on the external circuitry. Solder may then be flowed to complete the connection.

[0037] Signal routing layer 414 includes electrical traces or transmission lines (not shown) coupling RFIC 104 to each of the antenna elements 314, 304, 306 disposed on the flexible substrate 412. Since phased array beam scanning is based, in part, on the difference in reception times (or transmission times) of the RF signal at each of the phased array antenna elements 314, 306, it may be advantageous to reduce other sources of timing differences between signals at each of the those antenna elements 314, 306. In some embodiments, therefore, the electrical traces may be routed through the signal routing layer 414 in a variety of meandering patterns to achieve an equalized trace length, and thus an equalized signal delay time, between the RFIC 104 and each of the phased array antenna elements 314, 306. The term “equalized” as used herein, means that the difference in lengths between each of the traces is reduced to a sufficiently small value such that a desired level of beam scanning performance may be achieved. This is illustrated in FIG. 5, which shows RFIC 104 coupled to phased array antenna elements 314a and 314b through electrical traces 502 and 504 respectively. Due to the layout of phased array antenna elements 314a and 314b, electrical trace 504 is routed with a bend in the trace 508 that results in electrical trace 504 being longer than electrical trace 502. This may be corrected by re-routing electrical trace 502
along the path indicated as electrical trace 506, which has a meandering section 510, to equalize the lengths of the two traces 506 and 504.

[0038] Alternatively, the electrical traces may be routed through the signal routing layer 414 in a manner that results in known timing differences between the RFIC 104 and each of the phased array antenna elements 314, 306, such that corrections for those known timing differences may be applied in subsequent processing stages to compensate for those differences.

[0039] Returning now to FIG. 4, there is also shown an optional baseband integrated circuit (BBIC) 402, which is configured to generate baseband and intermediate frequency (IF) signals to be provided to RFIC 104. BBIC 402 may be deployed on the flexible substrate 412, as shown, or may be deployed elsewhere on the platform and coupled to RFIC 104 through any suitable enabling mechanism. Optional card module 404 is also shown and may be configured to provide lower frequency signals such as digital, power and ground signals as required. Due to the lower frequencies involved, card module 404 may employ standard printed circuit board (PCB) laminate technologies (e.g., the National Electrical Manufacturing Association (NEMA) FR-4 standard) for reduced manufacturing cost. In some embodiments, card module 404 may be a peripheral component interconnect express (PCIe) module.

[0040] FIG. 6 illustrates a system block diagram 600 of one exemplary embodiment consistent with the present disclosure. Shown are RFIC 104, antenna elements 314, which may be configured as phased array antenna elements, and antenna element 304 which may be configured as a single antenna element, such as for example an omni-directional or other fixed beam pattern or high gain antenna element. Also shown are BBIC 402 and phased array controller 624.

[0041] The RFIC 104 may be a bidirectional circuit, configured to both transmit and receive. In the transmit direction, an IF signal 604 may be provided to RFIC 104 from BBIC 402. An RF carrier is generated by RF carrier generator 608 and mixed with IF signal 604 by mixer 606 to up-convert the IF signal 604 to an RF signal. Mixer 606 may be a passive bi-directional mixer. The RF signal may be amplified by bi-directional amplifier 610 and then coupled to one or more single element antennas 304 (only one shown) and/or one or more phased array antenna systems 622 (only one shown). The single element antenna 304 transmits the RF signal in a fixed beam pattern. The phased array antenna system 622 transmits the RF signal in a scanned beam pattern, the direction of which is adjustable. To accomplish this, the RF signal is split by splitter/summer 614 and fed to a plurality of transceivers 616. Each transceiver 616 is configured with a phase shifter 618 capable of independently adjusting the phase of the split RF signal being fed to that transceiver 616. The phase shifted RF signal is further amplified by power amplifier (PA) 620 and fed to the antenna element 314 associated with the transceiver 616.

[0042] The phase shifter 618 may be under the control of phased array controller 624, which controls the amount and timing of the phase shift adjustments for each transceiver 616. By independently adjusting the phase of each of the split RF signals transmitted through each antenna element 314, a pattern of constructive and destructive interference may be generated between the antenna elements 314 that results in a beam pattern of a desired shape that can be steered to a particular direction. By varying the phase adjustments in real-time, the resultant transmit beam pattern can be scanned through a desired range of directions. In some embodiments the phased array controller 624 may be a general purpose processor, a digital signal processor (DSP), programmable logic or firmware.

[0043] A similar process may operate in the receive direction. Each antenna element 314 receives an RF signal which is processed by associated transceiver 616, where it is amplified by low noise amplifier (LNA) 620 and phase shifted by phase shifter 618 under control of phased array controller 624. The outputs of each transceiver 616 are summed by splitter/summer 614. Received RF signals arriving from different directions generally reach each of antenna elements 314 at different times. Phase shifting, which is equivalent to time shifting, may be employed to time align the received RF signals arriving from a particular direction while leaving received RF signals arriving from other directions unaligned. The summation of these RF signals by splitter/summer 614 results in a gain for the time aligned components associated with signals arriving from that particular direction. This results in a beam pattern gain in that direction. By varying the phase adjustments in real-time, the resultant receive beam pattern can be scanned through a desired range of directions.

[0044] The received RF signal, from either phased array antenna system 622 or single element antenna 304, may be further amplified by bi-directional amplifier 610 and then mixed by mixer 606 with the RF carrier generated by RF carrier generator 608 to down-convert the RF signal to an output IF signal 604 which is sent to BBIC 402 for baseband processing.

[0045] In some embodiments, the system is configured to operate on RF signals in the frequency range from 57-60 GHz and IF signals in the frequency range from 11.4-13.2 GHz. Baseband signals may be in the approximate range of 2 GHz.

[0046] FIG. 7 illustrates a flowchart of operations 700 of one exemplary embodiment consistent with the present disclosure. At operation 710, a plurality of antennas are configured on a conformal material. The conformal material is capable of conforming to a contour of a platform. At operation 720, driver circuitry is coupled to each of the plurality of antennas. The driver circuitry may include a plurality of transceivers. In some embodiments, the driver circuitry comprises a single RFIC configured to operate in the mm-wave frequency range and may include a mixer, a splitter, a plurality of low noise amplifiers and a plurality of power amplifiers. At operation 730, the plurality of transceivers are configured to provide independently adjustable phase delay to each of the plurality of antennas. The phase delay may be adjusted to implement phased array beam forming.

[0047] Embodiments of the methods described herein may be implemented in a system that includes one or more storage mediums having stored thereon, individually or in combination, instructions that when executed by one or more processors perform the methods. Here, the processor may include, for example, a system CPU (e.g., core processor) and/or programmable circuitry. Thus, it is intended that operations according to the methods described herein may be distributed across a plurality of physical devices, such as processing structures at several different physical locations. Also, it is intended that the method operations may be performed individually or in a subcombination, as would be understood by one skilled in the art. Thus, not all of the operations of each of the flow charts need to be performed, and the present disclo
sure expressly intends that all subcombinations of such operations are enabled as would be understood by one of ordinary skill in the art.

[0048] The storage medium may include any type of tangible medium, for example, any type of disk including floppy disks, optical disks, compact disk read-only memories (CD-ROMs), compact disk rewritable (CD-RWs), digital versatile disks (DVDs) and magneto-optical disks, semiconductor devices such as read-only memories (ROMs), random access memories (RAMs) such as dynamic and static RAMs, erasable programmable read-only memories (EPROMs), electrically erasable programmable read-only memories (EEPROMs), flash memories, magnetic or optical cards, or any type of media suitable for storing electronic instructions.

[0049] “Circuitry”, as used in any embodiment herein, may comprise, for example, singly or in any combination, hard-wired circuitry, programmable circuitry, state machine circuitry, and/or firmware that stores instructions executed by programmable circuitry.

[0050] The terms and expressions which have been employed herein are used as terms of description and not of limitation, and there is no intention, in the use of such terms and expressions, of excluding any equivalents of the features shown and described (or portions thereof), and it is recognized that various modifications are possible within the scope of the claims. Accordingly, the claims are intended to cover all such equivalents. Various features, aspects, and embodiments have been described herein. The features, aspects, and embodiments are susceptible to combination with one another as well as to variation and modification, as will be understood by those having skill in the art. The present disclosure should, therefore, be considered to encompass such combinations, variations, and modifications.

1. A system, comprising:
   a plurality of antennas configured on a conformal material, said conformal material capable of conforming to a contour of a platform; and
   driver circuitry coupled to each of said plurality of antennas, wherein said driver circuitry comprises a plurality of transceivers, said plurality of transceivers configured to provide independently adjustable phase delay to each of said plurality of antennas.

2. The system of claim 1, wherein said plurality of transceivers implement phased array beam scanning by controlling said adjustable phase delay to each of said plurality of antennas.

3. The system of claim 2, wherein said phased array beam scanning is oriented to a plurality of orthogonal directions.

4. The system of claim 1, wherein said driver circuitry comprises a single radio frequency integrated circuit (RFIC) configured to operate in a millimeter wave frequency range.

5. The system of claim 4, wherein said RFIC further comprises a mixer, a splitter, a plurality of low noise amplifiers and a plurality of power amplifiers.

6. The system of claim 1, wherein said conformal material conforms to said contour of said platform along a plurality of dimensions of said platform.

7. The system of claim 1, wherein said coupling from said driver circuitry to said plurality of antennas comprises a plurality of transmission lines, said plurality of transmission lines configured in length to provide an equalized propagation delay between each of said plurality of transceivers and each of said plurality of antennas.

8. A method, comprising:
   configuring a plurality of antennas on a conformal material, said conformal material capable of conforming to a contour of a platform;
   coupling driver circuitry to each of said plurality of antennas, wherein said driver circuitry comprises a plurality of transceivers; and
   configuring said plurality of transceivers to provide independently adjustable phase delay to each of said plurality of antennas.

9. The method of claim 8, further comprising implementing phased array beam scanning by controlling said adjustable phase delay to each of said plurality of antennas.

10. The method of claim 9, further comprising orienting said phased array beam scanning to a plurality of orthogonal directions.

11. The method of claim 8, wherein said driver circuitry comprises a single RFIC configured to operate in a millimeter wave frequency range.

12. The method of claim 11, wherein said RFIC further comprises a mixer, a splitter, a plurality of low noise amplifiers and a plurality of power amplifiers.

13. The method of claim 8, further comprising conforming said conformal material to said contour of said platform along a plurality of dimensions of said platform.

14. The method of claim 8, wherein said coupling from said driver circuitry to said plurality of antennas comprises a plurality of transmission lines, said plurality of transmission lines configured in length to provide an equalized propagation delay between each of said plurality of transceivers and each of said plurality of antennas.

15-20. (canceled)