

MULTIPORT ANTENNA

The invention relates to a multiport antenna used, in particular, in the field of radiogoniometry. It relates to the field of ultra-wideband antennas and systems of antennas, for example compact systems operating in the very high frequency VHF and ultra high frequency bands for the reception of electromagnetic waves without distinguishing between polarizations. It is also possible for it to be used in the high frequency or HF field. It is intended for reception applications, although transmission applications are possible.

Modern radiogoniometry systems are based, for the most part, on measuring and processing amplitude and phase data received by multiple radiating elements combined in an array. These data are referred to as complex antenna responses and the levels of performance of these systems are directly linked to the degree of diversity contained in these data. The sensitivity of the sensor also depends on the levels of performance of the radiating elements in terms of gain. Furthermore, integrating such a sensor within a vehicle, or simply transporting it, entails the antenna array having a high level of compactness. Added to this ever more restrictive constraint is the requirement to integrate arrays covering other frequency domains, along with a need for visual discretion. Nevertheless, sensitivity and precision in determining the direction of arrival cannot be sacrificed. In this context, the concept of compactness could be characterized by the capacity of the array to be contained within a cubic volume of smaller than thirty centimetres a side for a VHF/UHF application. Thus, for frequencies of a few tens of to a few hundred MHz, producing a radiating element contained within such a small volume is already particularly complex. Considered to be small in electrical terms, its impedance matching is often carried out by inserting an attenuator which masks the standing waves and which further decreases the effectiveness of the radiation, or through the use of active matching. To maintain a satisfactory level of gain from 30 MHz, it is then necessary to employ families of antennas occupying at most the allotted volume.

Additionally, producing an antenna array comprising multiple radiating elements in this same volume is even more difficult and clearly represents one of the main problems that designers have to solve.

What is more, the assembly of ultra wideband antennas leads to
5 coupling phenomena between the antennas and with the supporting structure. They lead to resonances which are often incompatible with a target application and with the required frequency domain, the latter being more than a decade. Added to these difficulties is the integration of the sensor within a complex operational environment, such as the roof of a vehicle,
10 which leads to coupling effects negatively affecting the radiation patterns of the antennas, their gain, and also their polarization state. This latter observation leads to envisaging sensors capable of handling polarization diversity in order to increase the reliability of their detections.

A logical way in which to handle this polarization diversity naturally
15 consists of diversifying the polarization state of the antennas forming the array. For example, certain radiating elements may exhibit a linear vertical polarization, while others have horizontal polarization.

Another difficulty encountered is the mechanical production of such systems, which leads to constraints in terms of cost and resistance to
20 harsh environments.

Various antennas and antenna arrays are described in the prior art, some examples of which will be given below.

For frequencies of a few tens of to a few hundred MHz, compact radiogoniometry arrays do not offer sufficient phase diversity whenever the
25 radiating elements used without beamforming are omnidirectional. Thus, the solutions brought to market by the company Rohde and Schwarz with the reference ADD197® and by the company TCI for the device 647D® are capable of reception with vertical polarization and with horizontal polarization but have a bulky diameter of over one metre. The solution by the company
30 TCI is composed of radiating elements which resemble sectorial antennas of *Vivaldi* type (a term known to those skilled in the art), but their dimensions

make setting up directional radiation in the VHF band unlikely. Moreover, these two solutions are composed, for each polarization, of nine radiating elements whose very small dimensions entail the use of active impedance matching. However, this method increases their electromagnetic susceptibility in the presence of co-site emissions. Lastly, this substantial number of elements imposes a switching cycle which is longer than that required with a lower number of ports, or imposes having recourse to complex reception architecture.

By making use of an Adcock antenna array (a familiar term in the field of antennas), consisting of combining omnidirectional elements in phase opposition or through the use of loops in the bidirectional radiation pattern, it is possible to obtain a particularly compact array whose number of ports is limited. Used with an algorithm of Watson-Watt type or vector correlation, this array possesses two crossed bidirectional channels, each with one lobe at 0° and one lobe at 180° of relative phase, supplemented by an omnidirectional channel indicating the phase reference. This conventional schema reduces the number of ports to three with single polarization. Their dimensions are very close to the set objective. However, no such solution exists, as far as the applicant is aware, with polarization diversity.

Another solution for obtaining the required compactness while providing a polarization diversity handling capability is described in the document by A. Nehorai and E. Paldi, entitled "Vector Sensor Processing for Electromagnetic Source Localization", Proc. 25th Asilomar Conf. Signals, Syst. Comput., pp. 566-572, Pacific Grove, CA, Nov. 1991. The described array is composed of three loops and three dipoles. This type of array makes it possible, in theory, to determine the direction of arrival of an electromagnetic wave of any polarization, for any azimuth and any elevation.

The patent application US20140266888 presents an antenna that makes it possible to determine the direction of arrival of ionospheric paths from 3 to 30 MHz, and distinguish between polarization states. V/UHF transposition in a frequency domain of more than a decade nonetheless

appears to be difficult. Specifically, the concept is based on the use of loop antennas which are small in electrical terms, de facto limiting the bandwidth and/or the sensitivity of the sensor.

5 Lastly, the patent US 8228258 presents an embodiment based on the multiport or multiple-port antenna concept. Optimized for narrowband applications, when the shape of the radiating strand creates maximum isolation between the three ports, it offers the equivalent of three sectorial antennas 101, 102, 103 in a compact format.

10 The main drawback of the solutions with dual polarization known to the applicant is their bulk, which does not allow the array to be easily transported once it has been offloaded, nor allow them to be integrated within certain types of carriers. The arrays conforming to fixed integration constraints, for their part, do not allow multiple polarizations to be handled. For vector antennas, it appears to be difficult to obtain an array which is both
15 sensitive and wideband over a frequency domain of more than a decade. Lastly, the multiport antennas developed until now appear to be reserved for narrowband applications with antenna diversity for reception, or for transmission and reception, of SIMO/MIMO (*single input multiple output/multiple input multiple output*) type with a number of channels limited
20 to two or three.

By way of example, existing V/UHF goniometry arrays do not simultaneously allow:

- a diameter and height close to 30 cm;
- self-matching radiating elements, not requiring active impedance
25 matching;
- multipolarization receiving capability with a limited number of radiating elements (six to eight);
- a gain for each primary polarization suitable for 30 MHz and without additional loss at 500 MHz, in order to preserve the
30 sensitivity of the sensor.

Throughout the rest of the description, the term "motif" or "antenna motif" refers to an antenna element which has a sectorial radiation pattern with a given polarization, for example a loaded folded dipole. The term vertical motif will refer to a motif with vertical polarization and the term horizontal motif will refer to a motif with horizontal polarization.

The subject of the invention relates to a multiport antenna characterized in that it comprises at least two antenna motifs formed by circular symmetry and having a sectorial radiation pattern with a first polarization P1, the two motifs being mutually interconnected by conductive parts that they share and the two motifs comprise at least two ports.

According to a first variant embodiment, the antenna is composed of two shapes having one and the same centre, a first, outer shape and a second, inner shape connected by at least two conductive parts, a motif with a first polarization P1 is formed by a first portion of the first shape and a first portion of the second shape, the two portions being connected by at least one first conductive part, said motif comprising at least one load and at least one port positioned opposite the load.

According to another variant embodiment, the multiport antenna is composed of two concentric circles, a first, outer circle of diameter ϕ_a and a second, inner circle of diameter ϕ_b connected by at least two radial conductive parts, a motif with a first polarization P1 is formed by a first portion of the first circle and a first portion of the second circle, the two portions being connected by at least one first conductive part, said motif comprising at least one load and at least one port positioned opposite the load.

According to another variant embodiment, the multiport antenna comprises at least one motif with a second polarization P2 that is different from the first polarization P1, said motif comprises a first portion and a second portion, the two portions being connected by at least one radial conductive part shared with the motifs having the first polarization P1, said

motif having the second polarization P2 comprises a port and a load positioned opposite a port, for one and the same motif.

The antenna may comprise a lower portion formed by symmetry with an upper portion, each portion comprising at least two motifs with a first polarization, each motif is endowed with a port and/or with a load, the lower
5 portion of the antenna and the upper portion being connected by at least one motif with a second polarization P2.

The multiport antenna has for example, a height H and a width L, the value of the L/H ratio being chosen to optimize the sectorial radiation
10 pattern Rs of a motif.

The first polarization P1 and the second polarization P2 are orthogonal polarizations, with a horizontal polarization P_H and a vertical polarization P_V , respectively.

The antenna may comprise at least three motifs with vertical polarization connected to one another by motifs with horizontal polarizations, the motifs being positioned to form a circular antenna.
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According to another variant embodiment, the antenna according to the invention comprises at least:

- an upper portion formed by four motifs with horizontal polarization, each motif sharing a radial conductive portion with its adjacent motif, each horizontal motif comprises a port and a load, a port being positioned opposite the load of one and the same motif;
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- four motifs with vertical polarization, each vertical motif comprising a first portion and a second portion, the two portions being connected by a radial conductive part shared with the adjacent horizontal motifs, each vertical motif comprises a port and a load;
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- a lower portion, symmetrical with the upper portion, comprising four motifs with horizontal polarization, each motif sharing a radial conductive portion with its adjacent motif, each motif comprises a port and a load, the four horizontal motifs are electrically connected by virtue of the radial conductive parts that they share.
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A motif forming the antenna may have a tubular structure whose geometry and dimensions are suitable for passing signal transmission or power supply cables therethrough.

A motif with vertical polarization and/or a motif with horizontal polarization may be a loaded folded dipole.

The multiport antenna comprises, for example, a support plate and a mast.

The antenna may be a receiving antenna. It may be used in VHF/UHF frequency bands. It may also be used for radiogoniometry.

Other features and advantages of the present invention will become more clearly apparent upon reading the description of exemplary embodiments given by way of wholly non-limiting illustration, alongside the figures which show:

- Figure 1, an exemplary multiport antenna according to the prior art;
- Figures 2A and 2B, a first example of a multiport antenna according to the invention comprising four horizontal elementary motifs and two vertical elementary motifs;
- Figures 3A to 3C, an exemplary multiport antenna, based on four vertical motifs and eight horizontal motifs, according to the invention;
- Figure 4, a representation of the coupling terms, in dB, between the ports as a function of frequency;
- Figure 5 and Figure 6, a representation of radiation patterns; and
- Figures 7A to 7C, an exemplary embodiment of a multiport antenna with three vertical motifs and six horizontal motifs.

In order to better understand the architecture of the antenna according to the invention, the following examples are given with the assumption that the antenna motif is a loaded folded dipole. Without departing from the scope of the invention, any antenna motif allowing a sectorial radiation pattern could also be used.

Figures 2A and 2B illustrate a first exemplary embodiment of a multiport antenna according to the invention.

Figure 2A schematically shows a multiport antenna with horizontal polarization and circular symmetry with two elements, sufficient for nominal operation of the invention. The antenna is composed of two concentric shapes, for example an outer circle 200a of diameter ϕ_a and an inner circle 200b of diameter ϕ_b connected by radial conductive parts 200_{ij}, the number of which is equal to the number of horizontal motifs of the antenna. The assembly formed by a first half of the outer circle 200a, a first half of the inner circle 200b, the two portions being connected by a first conductive part 200_{r1} and a second conductive part 200_{r2}, forms a first horizontal motif 210. Likewise, the assembly formed by the second half of the outer circle 200a and the second half of the inner circle 200b, connected by the aforementioned first and second conductive portions, forms a second horizontal motif 220. Each motif 210, 220 comprises a port 211, 221 and a load 212, 222, a port being positioned opposite the load of one and the same motif. The two horizontal motifs are thus electrically connected by virtue of the radial conductive parts that they share. Without departing from the scope of the invention, the antenna will potentially be formed by non-circular shapes having one and the same centre, such as polygons or any other shape.

Figure 2B shows a view of a multiport antenna according to the invention, constructed on the basis of the antenna of Figure 2A to which two motifs with vertical polarization P_V are added. A motif 230 comprises, for example, a first portion 230a and a second portion 230b, the two portions being connected by a radial conductive part 200_{r1} shared with the horizontal motifs. A motif with vertical polarization 230, 240 comprises a port 231, 241 and a load 232, 242 positioned opposite a port for one and the same motif.

The lower portion of the antenna is formed by symmetry with the upper portion. Two motifs with horizontal polarization 250, 260, akin to the motifs 210 and 220, are added in order to form the lower portion of the antenna with a port 251, 261 and a load 252, 262. The two horizontal motifs are thus electrically connected by virtue of the radial conductive parts 200'_{r1}, 200'_{r2} that they share.

The radial portions make it possible to ensure electrical continuity between the various elements forming a motif of the antenna. The two horizontal motifs of the lower portion will not necessarily be operational. For example, when they are positioned in the vicinity of a support plate, the port
 5 will be replaced by a load through a principle of balance with the characteristic impedance of the ports. The same applies for any port which would go unused.

The motifs with horizontal polarization and the motifs with vertical polarization are, in this example, loaded folded dipoles. One motif will be
 10 positioned such that its port allows a sectorial radiation pattern R_s , for example towards the outside of the antenna 200, while a load will instead be positioned towards the inside of the antenna. According to the same aforementioned balancing principle, it is nevertheless possible to replace the loads with ports in order to take advantage of additional transmission or
 15 reception channels.

The multiport antenna thus formed is defined, in particular, by its height H and the width L of an elementary motif. The height H substantially corresponds to the length of a vertical element forming the vertical motif and the width L corresponds to $(\phi_a - \phi_b)/2$. In general, the choice of the value of
 20 the L/H ratio will be made so as to optimize the front/back ratio of the pattern R_s with respect to the level of cross polarization exhibited by a single motif.

The presence of a load 212 of, for example, 200Ω , located opposite the power supply port 211, guarantees stability of its impedance over a very wide frequency band.

25 Figures 3A, 3B and 3C represent an antenna 300, a first view from above, an isometric view and a view integrating a support plate 400 and a service mast 410, respectively, of a multiport antenna composed of four vertical motifs and four horizontal motifs for a total of eight ports. The four horizontal motifs located in the lower portion, formed by symmetry with the
 30 upper portion, are not used in this example, since they are located in direct

proximity to the support plate 400. A role of the plate 400 is, for example, as a separator for other antenna elements or other antennas.

Figure 3A diagrammatically shows the arrangement of the four motifs with horizontal polarization, constructed in a manner similar to that of the representation of Figure 2A. The upper portion of the antenna 300 is composed of two concentric shapes, for example an outer torus 300a of diameter ϕ_a and an inner torus 300b of diameter ϕ_b connected by radial conductive parts 300_{rj}, the number of which is equal to the number of horizontal motifs of the antenna. The assembly formed by a quarter of the outer circle 300a, a quarter of the inner circle 300b, the two portions being connected by a first conductive part 300_{r1} and a second conductive part 300_{r2}, forms a first horizontal motif 310. The upper portion is thus constructed by four motifs with horizontal polarization 310, 320, 330, 340, each sharing a radial conductive portion with its adjacent motif. Each motif 310, 320, 330, 340 comprises a port 311, 321, 331, 341 and a load 312, 322, 332, 342, a port being positioned opposite the load of one and the same motif. The four horizontal motifs are thus electrically connected by virtue of the radial conductive parts that they share, 300_{r1}, 300_{r2}, 300_{r3}, 300_{r4}.

Likewise, the motifs with vertical polarization are defined (Figure 3B) according to the principle given in Figure 2B. The antenna 300 is constructed by duplicating, through rotation, a motif with vertical polarization. For example, the angle α between two vertical motifs will correspond to 90° , which will allow uniform azimuthal coverage over 360° to be obtained. This arrangement makes it possible to form the equivalent of a circular array with four sectorial elements, of which the vertical polarization is predominant. A motif with vertical polarization 350, 360, 370, 380 comprises, for example, a first portion 350a, 360a, 370a, 380a and a second portion 350b, 360b, 370b, 380b, the two portions being connected by a radial conductive part 300_{r1}, 300_{r2}, 300_{r3}, 300_{r4} shared with the adjacent horizontal motifs. Each vertical motif 350, 360, 370, 380 comprises a port 351, 361, 371, 381 and a load 352, 362, 372, 382, positioned opposite a port for one and the same motif.

The lower portion is formed by symmetry with the upper portion. It thus comprises four motifs with horizontal polarization 310', 320', 330', 340', each of which shares a radial conductive portion 300'_{r1}, 300'_{r2}, 300'_{r3}, 300'_{r4} with its adjacent motif. Each motif 310', 320', 330', 340' comprises a port 311', 321', 331', 341' and a load 312', 322', 332', 342', a port being positioned opposite the load of one and the same motif. The four horizontal motifs are thus electrically connected by virtue of the radial conductive parts that they share, 300'_{r1}, 300'_{r2}, 300'_{r3}, 300'_{r4}. These latter four elements will not be used in this example since they are positioned in proximity to the support plate 400 (figure 3C) and are therefore always loaded through a technique known to those skilled in the art for making radiation patterns symmetrical and improving the level of decoupling with the support plate, and a port will be replaced with a load.

A motif with horizontal polarization or with vertical polarization has a tubular section in this example in order to allow port power supply cables (not shown for the sake of simplicity) to pass through from the service mast 410.

The antenna is then characterized by its external diameter $\varnothing_a$, which is determined with respect to the volume constraint (30 cm in this example), by its internal diameter $\varnothing_b$ and by its height H. The height H is determined, for example, according to the maximum usage frequency of the antenna (close to $\lambda/2$), the internal diameter $\varnothing_b$ is chosen so as to optimize the radiation pattern (front/back ratio) and, simultaneously, the level of cross polarization, then the value of L is deducted. Once the height of the antenna H, and hence of the vertical motifs, has been chosen, for example, to be substantially equal to the external diameter, the levels of performance with the two main polarizations are then similar. Thus, for V/UHF operation, the solutions with three motifs with vertical polarization and three motifs with horizontal polarization (figures 7A to 7C), or six ports, and with four motifs with vertical polarization and four motifs with horizontal polarization, or eight ports, for example, both have a height of 25 cm for an external diameter of

27 cm, which dimensions must be added to the diameter of the tubes which is chosen, in particular, according to the diameter and the number of cables that have to pass through the tubes. An internal diameter of 12 cm is then deducted from these values.

5 Figure 4 represents the level of coupling, in dB, that exists between:

- two ports corresponding to contiguous vertical elements 450;
- two ports corresponding to contiguous horizontal elements 460;
- one vertical port and one horizontal port, which are contiguous 470.

10 It is thus possible to show that the level of coupling is of the same order as that obtained with two ultra wideband antennas which are separated by their excitation of 30 cm.

 Figure 5 schematically shows a radiation pattern, in terms of azimuth, of a vertical element with vertical polarization and with zero angle of elevation for the following frequencies: 30 MHz, 510, 100 MHz, 520, 500 MHz, 530.

 Figure 6 schematically shows a radiation pattern, in terms of azimuth, of a horizontal element with horizontal polarization and with zero angle of elevation for the frequencies 30 MHz, 610, 100 MHz, 620 and 500 MHz, 630.

 Figures 7A to 7C show a version with six antenna ports. This antenna is constructed in a similar manner to the antenna with four motifs with vertical polarization, this time using three horizontal motifs 710, 720, 730, for the upper portion and three vertical motifs 740, 750, 760, and with an angle α of 120° between the vertical motifs. The antenna 700 may also comprise three horizontal motifs 710', 720', 730' positioned in the lower portion of the antenna. In this example, a vertical motif is duplicated through rotation in order to obtain motifs positioned with an angle of 120° between them. This again allows an antenna sweep of 360° . Each horizontal motif 710, 720, 730, 710', 720', 730' or vertical motif 740, 750, 760 comprises a port 711, 721, 731, 711', 721', 731', 741, 751, 761 and a load 712, 722, 732,

712', 722', 732', 742, 752, 762. The ports for the motifs positioned in the lower portion are replaced by loads if the antenna comprises a plate 400.

Two horizontal motifs are thus electrically connected by virtue of the radial conductive parts 700ri that they share. A vertical motif is connected
5 to a horizontal motif by virtue of a radial conductive part.

The last two figures also show that the patterns obtained are relatively stable as a function of the frequency, even if the elements tend to become omnidirectional as the frequency increases. This is not an issue, however, since phase diversity appears as the frequency increases.

10 The multiport antenna according to the invention makes it possible, in particular, to meet the gain and polarization demands with a number of ports limited by applications in a small space. Each port thus takes advantage of all or part of the structure in order to increase electromagnetic performance levels. On the other hand, the multiport antenna makes it
15 possible to eliminate resonant effects between the radiating elements. Moreover, for a V/UHF application, it requires no active element in order to operate. Lastly, the degree of diversity introduced by the directional elements provides an advantageous level of goniometric precision in spite of the compactness of the antenna.

Claims

- 1 – Multiport antenna (200, 300), comprising at least two antenna motifs formed by circular symmetry and having a sectorial radiation pattern with a first polarization P1 (210, 220), which are mutually interconnected by two conductive parts (200_{r1}, 200_{r2}) that they share and which comprise at least two ports (211, 221), characterized in that it is composed of two shapes having one and the same centre, a first, outer shape (200a) and a second, inner shape (200b) connected by at least two conductive parts (200_{ij}), a motif with polarization P1 is formed by a first portion of the first shape (200a) and a first portion of the second shape (200b), the two portions (200a, 200b) being connected by at least one first conductive part (200_{r1}), said motif comprising at least one load (212, 222) and at least one port (211, 221) positioned opposite the load.
- 2 – Multiport antenna (200) according to Claim 1 characterized in that it is composed of two concentric circles, a first, outer circle (200a) of diameter ϕ_a and a second, inner circle (200b) of diameter ϕ_b connected by at least two radial conductive parts (200_{ij}), a motif with polarization P1 is formed by a first portion of the first circle (200a) and a first portion of the second circle (200b), the two portions (200a, 200b) being connected by at least one first conductive part (200_{r1}), said motif comprising at least one load (212, 222) and at least one port (211, 221) positioned opposite the load.
- 3 – Multiport antenna according to Claim 2, characterized in that it comprises at least one motif (230) with a second polarization P2 that is different from the first polarization P1, said motif (230) comprises a first portion (230a) and a second portion (230b), the two portions being connected by at least one radial conductive part (200_{r1}) shared with the motifs having the first polarization P1, said motif having the second polarization P2 (230) comprises

a port (231) and a load (232) positioned opposite a port, for one and the same motif.

4 – Multiport antenna according to Claim 3, characterized in that it comprises
 5 a lower portion formed by symmetry with an upper portion, each portion comprising at least two motifs with a first polarization P1 (210, 220, 250, 260), which are endowed with a port (211, 221, 251, 261) and/or with a load (212, 222, 252, 262), the lower portion of the antenna and the upper portion being connected by at least one motif (230) with polarization P2.

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5 – Multiport antenna according to Claim 4, characterized in that it has a height H and a width L, the value of the L/H ratio is chosen to optimize the sectorial radiation pattern Rs of a motif.

15 6 – Multiport antenna according to one of Claims 2 to 5, characterized in that the polarization P1 and the polarization P2 are orthogonal polarizations, with a horizontal polarization P_H and a vertical polarization P_V, respectively.

7 – Multiport antenna according to Claim 6, characterized in that it comprises
 20 at least three motifs with vertical polarization connected to one another by motifs with horizontal polarizations, the motifs being positioned to form a circular antenna.

8 – Multiport antenna according to Claim 6, characterized in that it comprises
 25 at least:

- an upper portion formed by four motifs with horizontal polarization (310, 320, 330, 340), each sharing a radial conductive portion (300_{r1}, 300_{r2}, 300_{r3}, 300_{r4}) with its adjacent motif, each horizontal motif (310, 320, 330, 340) comprises a port (311, 321, 331, 341) and a load (312, 322, 332, 342), a port being positioned opposite the load of one and
 30 the same motif;

- four motifs with vertical polarization (350, 360, 370, 380), each vertical motif comprising a first portion (350a, 360a, 370a, 380a) and a second portion (350b, 360b, 370b, 380b) the two portions being connected by a radial conductive part (300_{r1}, 300_{r2}, 300_{r3}, 300_{r4}) shared with the adjacent horizontal motifs, each vertical motif (350, 360, 370, 380) comprises a port (351, 361, 371, 381) and a load (352, 362, 372, 382);
 - a lower portion, symmetrical with the upper portion, comprising four motifs with horizontal polarization (310', 320', 330', 340'), each of which shares a radial conductive portion (300'_{r1}, 300'_{r2}, 300'_{r3}, 300'_{r4}) with its adjacent motif, each motif (310', 320', 330', 340') comprises a port (311', 321', 331', 341') and a load (312', 322', 332', 342'), the four horizontal motifs are electrically connected by virtue of the radial conductive parts that they share (300'_{r1}, 300'_{r2}, 300'_{r3}, 300'_{r4}).
- 9 – Multiport antenna according to one of the preceding claims, characterized in that a motif with a tubular structure whose geometry and dimensions are adapted for passing signal transmission or power supply cables therethrough.
- 10 – Multiport antenna according to one of Claims 2 to 9, characterized in that a vertical motif and/or a horizontal motif is a loaded folded dipole.
- 11 – Multiport antenna according to one of Claims 3 to 10, characterized in that it comprises a support plate (400) and a mast (410).
- 12 – Multiport antenna according to one of the preceding claims, characterized in that the antenna is a receiving antenna.
- 13 – Multiport antenna according to one of Claims 1 to 12, characterized in that it is adapted for use in VHF/UF frequency bands.

14 – Use of the multiport antenna according to one of Claims 1 to 12 for radiogoniometry.