

LOW-COMPLEXITY MULTIAN TENNA COMMUNICATION SYSTEM AND ASSOCIATED METHOD

The invention lies in the field of radio communications, and more particularly in the field of radio communications for multiantenna systems.

The invention is used notably in the field of military radio communications.

When propagated in free space, an electromagnetic wave can be subjected to reflections in the propagation environment, the consequence of which is that it will reach the receiver via multiple paths, each having different power levels and propagation times.

The recombination of these various paths can lead to signal fading phenomena that affect the levels of performance of communications. By way of example, when fading follows an attenuation law called "Rayleigh law", the loss may be in the order of 20 to 30 dB according to the targeted level of performance.

To combat these signal fading phenomena, it is known practice to add diversity to the propagation channel. This diversity can be obtained in the time, frequency or space domain.

In the time domain, diversity is obtained by interleaving the data over a long period.

However, the use of a long interleaving period brings about an increase in message transmission latency. Furthermore, if the transmitter and the receiver are immobile, the propagation channel does not vary over the course of time, and time diversity does not solve the propagation problems.

In the frequency domain, diversity is obtained by coding and interleaving the message to be transmitted over a plurality of dwells, each of the dwells being transmitted on different carrier frequencies. This is the principle of frequency hopping, or FH.

Nevertheless, two disadvantages must be noted for the use of frequency diversity:

- The frequency resource can be rare for some applications. For example, this is the case for tactical applications implemented in the UHF (abbreviation for Ultra High Frequency) band, which is used in particular.
- Depending on the position of the equipment items, the hop band that is necessary in order to obtain frequency diversity may be very wide and require the use of very wideband equipment items imposing serious restrictions (restrictions on linearity, cost and compactness). This is the case for ground-to-air applications, for example, where the necessary bandwidths can exceed 1GHz.

In the space domain, diversity is obtained by using a plurality of antennas for transmission and/or reception, as opposed to the general case comprising one transmission antenna and one reception antenna, called the SISO (for Single Input Single Output) case.

The processing operations that need to be performed in order to make use of antenna diversity are dependent on the multiantenna configuration used:

- If the transmitter has a single antenna and the receiver has a plurality of antennas, called the SIMO (for Single Input Multiple Output) case, then the processing operations to be performed for reception consist in rephasing the signals received on each of the antennas, and in combining them.
- If the transmitter has a plurality of antennas and the receiver has a single antenna, called the MISO (for Multiple Input Single Output) case, then the processing operations to be performed consist in transmitting the signal on all the antennas by using space-time coding. The reception equipment item uses this space-time coding to distinguish between the signals from each of the transmission antennas, and recombines them in phase.

- If the transmitter and the receiver both have a plurality of antennas, called the MIMO (for Multiple Input Multiple Output) case, then the processing operations to be performed are those adapted to the MISO case and the SIMO case.

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However, the utilization of antenna diversity has a cost in terms of hardware architecture, since the addition of a supplementary antenna requires the addition of a supplementary radio chain in the equipment, which is incompatible with restrictions concerning small size.

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Furthermore, the supplementary processing operations to be performed in order to make use of antenna diversity, such as space-time coding, synchronization and estimation of the propagation channel for each of the antennas, and the recombination of the signals, require high computation powers, which is incompatible with restrictions concerning low

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consumption. Finally, the use of space-time coding for transmission must be anticipated in the phase of definition of the waveform used for transmission. Thus, MISO and MIMO processing operations are not compatible with all communication standards.

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Another alternative, which is used in networks having a base station connected to multiple terminals, consists in selecting one transmission antenna from a plurality at the base station, according to the quality of the transmission. This alternative requires the implementation of signalling dedicated to transmission of the quality of the propagation channel. It likewise requires specific time slots allowing estimation of the propagation channel between each of the antennas of the base station and each of the mobile terminals. This solution therefore introduces a certain latency into the choice of the antenna used on the base station, leading to less-than-optimum performance in the face of a rapidly varying propagation channel.

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Finally, receivers are known, such as in the European patent applications EP 1458120 A2 and EP 155767 A1, for example, having a plurality of antennas, the choice of antenna being made according to measurements of the quality of the signal on each antenna. These methods

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are not adapted to rapid variations in the propagation channel, as is the case when the receiver is moving in an urban environment, for example, and may be difficult to implement, since measurement of the quality of the signal on the unselected antenna requires the structure of the transmitted signal to
5 accommodate time intervals provided for this purpose.

The invention proposes a communication system and a method allowing the utilization of antenna diversity by using a plurality of antennas for transmission and/or a plurality of antennas for reception, for which the
10 supplementary restrictions in terms of hardware architecture and computation powers are small.

To this end, the invention proposes adding to equipment items dedicated to single-antenna communications a switching device that is connected to a plurality of antennas, and alternately using each of the
15 transmission and reception antennas. In this way, the communication will benefit from antenna diversity without requiring waveform adaptations or modifications to the architecture of the equipment items.

The invention is compatible with every type of waveform using transmission of the data in dwells, and with every multiple antenna pattern.
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The invention therefore consists in a communication system comprising two remote radio equipment items that can interchange data, said communication relying on a waveform transmitted in dwells, at least one of said radio equipment items including at least two antennas. The system is
25 characterized in that said or each said radio equipment item including at least two antennas comprises:

- an antenna switching means configured to select, for each dwell, one of said antennas according to at least one deterministic switching law, and
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- a control means for said antenna switching means.

Advantageously, said antenna selection law covers all of the transmission/reception antenna pairs in a statistically uniform manner.

Advantageously, said switching means comprises a first switching law allowing selection of an antenna when the equipment item is used for transmission and a second switching law allowing selection of an antenna when the equipment item is used for reception.

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Advantageously, said control means is configured to indicate to said switching means a transmission/reception state of the equipment item and the start of an interval between two dwells.

10 Advantageously, said data are coded and interleaved on a plurality of dwells of the waveform.

Advantageously, each radio equipment item including at least two antennas contains only a single transmission radio chain and/or a single
15 reception radio chain that can be selectively connected to said antennas by said antenna switching means.

In one embodiment of the communication system according to the invention, said antennas of each radio equipment item, including at least two
20 antennas are spaced apart by a gap greater than $\lambda/2$, λ being the wavelength linked to the transmission frequency.

In another embodiment of the communication system according to the invention, said antennas of each radio equipment item including at least
25 two antennas have different polarizations.

Advantageously, the antennas used on each radio equipment item including at least two antennas have substantially identical radiation patterns.

30 Advantageously, the waveform moreover implements a frequency hopping mechanism.

In another embodiment, said switching means is adapted to, on transmission, selectively connect said antennas to a single transmission

radio chain and to, on reception, connect said antennas to respective reception radio chains.

5 In another embodiment, said switching means is adapted to, on transmission, connect said antennas to respective transmission radio chains and to, on reception, selectively connect said antennas to a single reception radio chain.

10 The invention likewise consists in a communication method implemented in a radio equipment item including at least two antennas belonging to a communication system between two remote radio equipment items that can interchange data, said communication relying on a waveform transmitted in dwells, characterized in that the equipment item comprises an antenna switching means for switching antennas according to at least one
15 deterministic switching law, and a control means, and in that it comprises, for each of the dwells, the steps of:

- sending, by the control means, of a command to said antenna switching means, indicating a switching instant,
- selection, according to said switching law, of an antenna to be used,
20 and
- switching to the selected antenna.

Advantageously, the equipment item comprises a first switching law used for transmission and a second switching law used for reception, the
25 method moreover comprising the steps of:

- sending, by the control means, of a command to said switching means, indicating a transmission/reception state of the equipment item,
- selection of a switching law according to the transmission/reception
30 state of the equipment item.

Advantageously, the communication method moreover comprises a preliminary step of programming of at least one switching law. This step does not have to be performed for each of the dwells, and can be carried out
35 when the equipment item is initialized, or at predetermined instants.

The invention will be better understood and other features and advantages will better emerge on reading the description that follows, which is provided in nonlimiting manner, and by virtue of the appended figures, in which:

- 5 • Figure 1 shows a transmission equipment item and a reception equipment item using antenna diversity according to the prior art,
- Figure 2 shows an embodiment of a transmission equipment item and a reception equipment item according to the invention,
- 10 • Figure 3 shows a timing diagram for an example of the switching of the antennas of a transmission equipment item and a reception equipment item,
- Figure 4 gives two examples of antenna switching laws,
- 15 • Figure 5 shows an embodiment of an equipment item performing transmission according to the invention and reception according to an SIMO mechanism,
- Figure 6 illustrates a communication method according to the invention.

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All of the figures that follow mention equipment items used for transmission and equipment items used for reception. For a communication between two remote radio equipment items, that is to say a wireless point-to-point communication performed by means of the propagation of an electromagnetic wave in free space, each of the equipment items is alternately used for transmission and reception, the terminology transmission equipment item and reception equipment item being used to indicate the state of the equipment item at a precise instant.

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Figure 1 shows a transmission equipment item 100 and a reception equipment item 150 using antenna diversity according to the prior art. In the example, the transmission equipment item includes three antennas, and the reception equipment item includes two antennas.

Each of the equipment items contains a device 101 and 151 for performing all of the baseband processing operations.

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The processing operations are processing operations that are independent of the number of antennas 102 and 152 concerning the network layer, the data link layer and the physical layer. In particular, the processing operations concerning the physical layer comprise the steps of channel
5 coding and interleaving of the data.

The transmission equipment item having the possibility of transmitting on three antennas, space-time coding baseband processing operations 103 for the data allowing the utilization of antenna diversity will be
10 performed so as to generate three baseband signals.

These three baseband signals will each be transmitted to a transmission radio chain 111, 112 and 113, the role of which is to perform the transposition to carrier frequency.

Each of the signals on carrier frequency will then be transmitted by
15 an antenna 121, 122 and 123 dedicated to the radio chain.

The reception equipment item receives the signal on each of its two antennas 171 and 172, each of the signals subsequently being transposed to baseband by a dedicated reception radio chain 161 and 162.

20 The baseband processing device 151 will then recombine 153 the two signals. This recombination comprises estimation of the propagation channel for the signals received on each of the radio channels, and time and phase resynchronization of said radio channels.

25 Figure 2 shows an embodiment of a transmission equipment item 200 and a reception equipment item 250 using antenna diversity according to the invention.

In this embodiment, the transmission equipment item includes three antennas and the reception equipment item includes two antennas. In
30 order to optimize performance, the antennas are substantially identical, in particular their radiation patterns are similar, and operate in the same frequency bands. They differ only in their geographical location and/or their type of polarization.

This embodiment can be generalized to all antenna configurations in which at least one of the two equipment items comprises two antennas or more.

5 The transmission equipment item comprises a device 201 performing all of the baseband processing operations. These processing operations comprise processing operations for the network layer, for the data link layer and for the physical layer, in particular channel coding and interleaving of the data.

10 The signal in baseband is then transmitted to a single transmission radio chain 211, the role of which is to transpose the baseband signal to carrier frequency.

 The signal on the carrier frequency is transmitted to an antenna switching means 230, having one input and three outputs. The antenna
15 switching means allows selection of the antenna on which the signal will be transmitted. This antenna selection is made according to a preprogrammed switching law, the switching instant being determined by a control means 240.

 The control means 240 uses switching to deliver an information
20 item indicating whether the equipment item is used for transmission or for reception, and a signal indicating the instants at which the antenna changes need to take place. The control means is connected to the device 201.

 The antenna switching means 230 may be implemented inside an equipment item, in the case of modification of an existing set or design of a
25 new set, or else arranged as an interface between the radio set and the antennas.

 The reception equipment item performs the operations mirroring those carried out by the transmission equipment item.

30 It receives a signal via one of its antennas 271 and 272, the antenna used being chosen by the antenna switching means 280. The antenna switching means has two inputs and one output, and conforms to a preprogrammed switching law for the reception antenna. The switching instant is determined by a control means 290.

This control means uses switching to deliver an information item indicating whether the equipment item is used for transmission or for reception, and a signal indicating the instants at which the antenna changes need to take place. The control means is connected to the device 251.

5 The signal transmitted by the switching means is transposed to baseband by a single reception radio chain 261.

The invention is used for wireless communications using waveforms transmitted in dwells.

10 These dwells are separated by idle times, called inter-dwell times.

In order to transmit a data packet, these waveforms perform a first channel coding phase for the packet. The purpose of the channel coding, or error correction code, is to provide redundancy for the transmission data in order to correct any errors linked to the transmission.

15 The coded data are then interleaved and transmitted over a plurality of consecutive dwells. The aim of the interleaving step is to distribute errors from the various dwells. If one of the dwells is lost, then the errors are distributed over all of the coded data, rather than in a succession of consecutive errors. This interleaving step is not necessary when a block error
20 correction code is used, such as a turbo code or an LDPC code, for example, these having an internal interleaving mechanism by design.

This type of transmission is generally used for implementing frequency hopping mechanisms, the dwells being transmitted on a set of
25 carrier frequencies, with the aim of providing frequency diversity, increasing resistance to interference and making interception of the transmission more complex. The dwells are then spaced apart by inter-dwell times that are necessary for performing the change of carrier frequency for the equipment items.

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The invention relies on such a dwell-based waveform structure by modifying the pair of antennas that are used for the transmission equipment item and the reception equipment item at each dwell and by using the times
35 of the possible antenna combinations in a statistically uniform manner. The

data being interleaved and coded over the various dwells, if one of the antenna pairs has adverse propagation conditions, then the antenna diversity provided by the invention, associated with the error correction code, will allow the transmitted data packet to be recovered.

5 When the switching system comprises more than two members, it can be complex to determine, for each of the equipment items, a law allowing all of the antenna combinations of all of the equipment items to be covered. One solution to this problem consists in configuring each of the equipment items using two switching laws: a first law that is used for the transmission of
10 messages and a second law that is used for the reception of messages.

The invention is used for all waveforms using a dwell-based transmission structure, on condition that the inter-dwell time is compatible with the time that is necessary for antenna switching.

15 At the start of an inter-dwell, or at the end of a dwell, the equipment item used for transmission or reception uses antenna switching to transmit an information item indicating whether the equipment item is used for transmission or for reception, in association with a signal indicating the instant at which the switching needs to take place.

20 Depending on the transmission/reception state of the equipment item, the switching means selects the appropriate switching law, and the antenna to be used for the next dwell. It then performs the antenna switching.

 The time necessary for transmitting the information, selecting the switching law and implementing the switching must be less than the inter-
25 dwell time.

Figure 3 shows a timing diagram for an example of the switching of the antennas for a communication between a transmission equipment item having three antennas and a reception equipment item having 2 antennas.

30 The line 310 represents the periods corresponding to a dwell 311, and the periods corresponding to an inter-dwell 312.

The line 320 represents the selected antenna in a transmission equipment item having three antennas, which are called 1, 2 and 3.

 The line 330 represents the selected antenna in a reception
35 equipment item having two antennas, which are called A and B.

The antenna switching operations are performed during the inter-dwell times and are effective before the end of these inter-dwells. The transmission and reception equipment items are configured to comply with
 5 switching laws allowing all of the antenna pairs to be covered cyclically.

Various switching laws can be implemented for the antenna switching means. Some examples of laws are given below. N will be considered to be the number of antennas of the transmission equipment item, and M to be the number of antennas of the reception equipment item.
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This switching law is configurable and deterministic, the antenna switching being controlled by a law rather than performed on the basis of parameters specific to the reception of the signal, such as a measurement of power received on each of the antennas, for example.
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When the transmission equipment item has only one antenna, the antenna switching law for the reception equipment item conforms to the sequence (1, 2, ..., M).

When the reception equipment item has only one antenna, the
 20 antenna switching law for the transmission equipment item conforms to the sequence (1, 2, ..., N).

When N and M are prime among one another, it is possible to use the following law:

- the antenna switching law for the transmission equipment
 25 item conforms to the sequence (1, 2, ..., N), and
- the antenna switching law for the reception equipment item likewise conforms to the sequence (1, 2, ..., M).

When N and M are not prime among one another, it is possible to
 30 use the following law (the transmission and reception laws being able to be reversed):

- the antenna switching law for the transmission equipment item follows the sequence (1, 2, ..., N), and
- the antenna switching law for the reception equipment item
 35 follows the cycle (P1(M), P2(M), ... PM(M)), where $P_i(M)$ is

a circular permutation on the sequence (1, 2, ..., M) according to the formula $P_i(M) = (i, i+1, \dots, M, 1, 2, \dots, i)$.

When the number of antennas of the transmission and reception
5 equipment items is unknown, it is possible to use the following law (the transmission and reception laws being able to be reversed):

- the antenna switching law for the transmission equipment item follows the sequence (1, 2, ..., N), and
- the antenna switching law for the reception equipment item
10 follows a random, or pseudorandom law.

If the control means does not allow the transmission/reception state of the equipment to be transmitted to the switching means, the two equipment items can use random or pseudorandom antenna switching laws
15 so as to maximize the use of different antenna pairs.

Figure 4 give two examples of antenna switching laws.

In Example 1, the transmission equipment item comprises three antennas, and the reception equipment item comprises two.

20 The numbers of antennas of the two equipment items being prime among one another, the transmission equipment item follows the sequence (1, 2, 3) cyclically, while the reception equipment item follows the sequence (1, 2) cyclically.

Six independent antenna pairs are thus selected. The utilization of
25 antenna diversity is optimum. By using a single frequency, such a system allows levels of performance equivalent to those of a system performing frequency hopping on six frequencies to be obtained.

In the second example, the transmission equipment item and the
30 reception equipment item each comprise three antennas.

The numbers of antennas of the two equipment items not being prime, the transmission equipment item follows the sequence (1, 2, 3) cyclically, while the reception equipment item follows the sequence (1, 2, 3, 2, 3, 1, 3, 1, 2).

Nine independent antenna pairs are thus selected. The utilization of antenna diversity is optimum. By using a single frequency, such a system allows levels of performance equivalent to those of a system performing frequency hopping on nine frequencies to be obtained.

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The levels of performance of the system depend on the antenna diversity and therefore the antenna network used, the antennas of one and the same equipment item having substantially equivalent characteristics (gain, radiation pattern and wavelength).

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Antenna diversity can be obtained in two ways:

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- Space diversity: the antennas are arranged at different locations in space. Optimization of the antenna network depends on the type of application. The rules allowing a good compromise to be obtained between size of the antenna network and space diversity are as follows:

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- o for ground-to-ground applications: the antennas are arranged in a horizontal plane, keeping a minimum spacing between them in the order of $\lambda/2$ for a set on the ground and in the order of $5.\lambda$ to $10.\lambda$ for a set situated on a high point, such as a building for example, λ being the wavelength linked to the central frequency used for transmission.

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- o for ground-to-air applications: the antennas are arranged in a vertical plane, keeping a minimum spacing between them in the order of λ .

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- Polarization diversity: the antennas are co-located and are sensitive to two different types of polarization. For example, the antenna network can consist of two orthogonal cross-connected loop antennas or of two orthogonal dipoles (vertical and horizontal or at $\pm 45^\circ$).

The antenna network used can likewise combine the two diversity types, such as, by way of example, two co-located sensors of two

polarization diversity antennas situated at two points in space, thus allowing four antennas to be obtained.

5 The communication system according to the invention can be used together with a frequency hopping mechanism. Such an implementation allows the simultaneous utilization of frequency diversity and antenna diversity, and therefore an improvement in overall performance.

10 The communication system according to the invention can also be used when one of the sets benefits from SIMO (multiple antennas for reception) processing.

15 Figure 5 illustrates an embodiment of an equipment item according to the invention that allows it also to make use of SIMO processing capabilities.

In the example shown in Figure 5, the equipment item 500 comprises two antennas 521 and 522, a transmission radio chain 511 and two reception chains 512 and 513.

20 The switching means 540 is made up of three multiplexers 541, 542 and 543 allowing the antennas to be switched so that:

- for transmission, the equipment item uses the device according to the invention in order to selectively switch between the various antennas for each of the dwells of the waveform,
- 25 • for reception, the equipment item uses the two reception antennas connected to two respective reception chains, before performing the processing operations 153 for recombining the signals in baseband.

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Thus, when the equipment item is used for transmission, the number of frequencies that are used for frequency hopping can be divided by the number of antennas for identical performance levels.

The invention is used in an equivalent manner for an equipment item comprising N antennas, N transmission chains and a single reception chain, and performing MISO processing operations, the invention thus being used when the equipment is used for reception.

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The invention also addresses a method for making use of antenna diversity that is intended to be implemented on a transmission or reception equipment item in a system according to the invention.

The method consists of various software steps that are executed
10 by a reprogrammable computation machine (a processor or a microcontroller, for example) or by a dedicated computation machine (for example a set of logic gates such as an FPGA or an ASIC, or any other hardware module), controlling a hardware switching means for an antenna.

15 Depending on whether the antenna switching means is included in the equipment item or is positioned as an interface between the radio equipment item and the antennas, the method can be implemented in the control and switching means, or directly in the radio equipment item.

If the antenna switching means 230 and 280 is situated as an
20 interface for the equipment item, it can be made up of a multiplexer or electrical switching circuit associated with a dedicated computation machine that is programmed in order to select an antenna according to a switching law. The control means 240 and 290 is then made up of logic allowing interpretation of the signals from the equipment item indicating the
25 transmission/reception state of the equipment item and delivery of the starting instants of an inter-dwell from a clock or a signal delivered by the equipment item, and retransmission of them to the switching means.

If the antenna switching means is situated in the equipment item, the control of the switching means and the execution of the switching law can
30 be performed by the computation machine responsible for the baseband processing operations.

Figure 6 illustrates a communication method according to the invention.

The method consists of a first step 600, which is executed on initialization of the equipment item, for programming an antenna switching law. If the equipment item has a switching law for transmission and a switching law for reception, step 600 comprises programming of these two laws.

This or these law(s) depend on the number of antennas of the transmission and reception equipment items, as described above.

The method then performs a second step 601, which is performed by the control means, of sending to the switching means a switching instant, or the end of a transmission dwell, or the start of an inter-dwell.

When the switching means is configured to execute a first switching law during transmission and a second switching law during reception, the method then comprises a third step 602 of sending to the switching means a use state for the equipment item (transmission or reception).

A fourth step 603 of selection of a switching law according to the transmission/reception state of the equipment item is then performed, prior to a fifth step 604 of selection of an antenna, using the selected switching law.

Finally, the switching means performs a sixth step 605 of switching of the antenna used for transmitting the next dwell.

The communication system, and the associated method, therefore makes it possible to make use of antenna diversity for transmission while preserving the processing complexity and the radio architecture of a single-channel set.

It allows the utilization of antenna diversity for transmission and for reception while being independent of the waveform, and requires no modification of the set for transmission and for reception, except for the addition of an antenna switching means, and of an interface that supplies the switching means with the starting instants for a dwell and the state of the set, transmission or reception.

It conforms to switching laws during transmission and during reception that are preprogrammed according to the number of antennas for transmission and for reception.

Within contexts in which antenna diversity is sufficient, the solution
5 makes it possible to achieve frequency hopping performance levels by using
a small number of frequencies (divided by $N \cdot M$). The management of
frequency hopping is therefore simplified.

Within contexts in which frequency diversity is insufficient, the
solution allows the performance of a frequency hopping system to be
10 improved.

CLAIMS

1. Communication system comprising two remote radio equipment items (200 and 250) that can interchange data, said communication relying on a waveform transmitted in dwells, at least one of said radio equipment items including at least two antennas (221, 222, 223), characterized in that said or each said radio equipment item including at least two antennas comprises:
 - an antenna switching means (230) configured to select, for each dwell, one of said antennas according to at least one deterministic switching law, and
 - a control means (240) for said antenna switching means.
2. Data transmission system according to claim 1, in which said antenna selection law covers all of the transmission/reception antenna pairs in a statistically uniform manner.
3. Communication system according to either of the preceding claims, in which said switching means comprises a first switching law allowing selection of an antenna when the equipment item is used for transmission and a second switching law allowing selection of an antenna when the equipment item is used for reception.
4. Communication system according to one of the preceding claims, in which said control means is configured to indicate to said switching means a transmission/reception state of the equipment item and the start of an interval between two dwells.
5. Communication system according to one of the preceding claims, in which said data are coded and interleaved on a plurality of dwells of the waveform.
6. Communication system according to one of the preceding claims, in which each radio equipment item including at least two antennas contains only a single transmission radio chain (211) and/or a single reception radio

chain (261) that can be selectively connected to said antennas by said antenna switching means.

7. Communication system according to one of the preceding claims, in
5 which said antennas of each radio equipment item including at least two antennas are spaced apart by a gap greater than $\lambda/2$, λ being the wavelength linked to the transmission frequency.

8. Communication system according to one of Claims 1 to 6, in which
10 said antennas of each radio equipment item including at least two antennas have different polarizations.

9. Communication system according to one of the preceding claims, in
15 which the antennas used on each radio equipment item including at least two antennas have substantially identical radiation patterns.

10. Communication system according to one of the preceding claims, in which the waveform moreover implements a frequency hopping mechanism.

20 11. Communication system according to one of the preceding claims, in which said switching means is adapted to, on transmission, selectively connect said antennas to a single transmission radio chain (511) and to, on reception, connect said antennas to respective reception radio chains (512 and 513).

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12. Communication system according to one of the preceding claims, in which said switching means is adapted to, on transmission, connect said antennas to respective transmission radio chains and to, on reception, selectively connect said antennas to a single reception radio chain.

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13. Communication method implemented in a radio equipment item including at least two antennas (221, 222 and 223) belonging to a communication system between two remote radio equipment items (200 and 250) that can interchange data, said communication relying on a waveform
35 transmitted in dwells, characterized in that the equipment item comprises an

antenna switching means (230) for switching antennas according to at least one deterministic switching law, and a control means (240), and in that it comprises, for each of the dwells, the steps of:

- sending (601), by the control means, of a command to said antenna switching means, indicating a switching instant,
- selection (604), according to said switching law, of an antenna to be used, and
- switching (605) to the selected antenna.

10 14. Communication method according to Claim 13, in which the equipment item comprises a first switching law used for transmission and a second switching law used for reception, the method moreover comprising the steps of:

- sending (602), by the control means, of a command to said switching means, indicating a transmission/reception state of the equipment item,
- selection (603) of a switching law according to the transmission/reception state of the equipment item.

20 15. Communication method according to either of Claims 13 and 14, moreover comprising a preliminary step (600) of programming of at least one switching law.