Title: WIRELESS BROADBAND MOBILE STATION AND METHOD FOR MEASURING PREAMBLE AND DETERMINING EFFECTIVE SLEEP PERIOD

Abstract: A wireless broadband Internet (WiBro) terminal and a method of determining a sleep mode of a WiBro terminal, which can measure a strength of a preamble signal and determine an effective sleep interval are provided. A WiBro terminal, which can measure a strength of a preamble signal in the listening mode during an L frame after operating in a sleep mode during an N1 frame, and operate in a sleep mode during either an N1 or 2*N1 frames, or perform a normal operation when MOB_TRF_IND is positive, resulting from the comparing the strength with a threshold value, is provided.
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.
WIRELESS BROADBAND MOBILE STATION AND METHOD FOR MEASURING PREAMBLE AND DETERMINING EFFECTIVE SLEEP PERIOD

Technical Field

The present invention relates to a wireless broadband Internet (WiBro) terminal and a method of determining a sleep mode of a WiBro terminal, and more particularly, to a WiBro terminal and a method of determining a sleep mode of a WiBro terminal, which can measure a strength of a preamble signal in a listening mode, independently control a sleep mode operation, resulting from the comparing the strength with a threshold value, and perform a normal operation according to a predetermined indication signal.

Background Art

In a modern society, communication terminals are used for long distance communication devices by many people. In particular, a wireless broadband Internet (WiBro) terminal is a next generation communication terminal providing a mobile Internet function which enables many users to currently use a data service such as the Internet, and the like, regardless of a location.

FIG. 1 is a flowchart illustrating a method of determining a sleep mode in a WiBro terminal according to a conventional art.

As illustrated in FIG. 1, when a mobile station (MS) transmits a mobile sleep request (MOB_SLP_REQ) message to a base station (BS), the BS transmits, via a mobile sleep response (MOB_SLP_RSP) message, a parameter related to sleep such as Min_sleeping interval N1, Max_sleeping interval N2, Listening interval L1, and the like (S10). Accordingly, the MS enables sleep and listening to repeat according to the parameters. Specifically, when the MS receives the MOB_SLP_RSP message from the BS, the MS first enters a sleep mode of at least Min_sleeping interval N1, enters an awake mode at Listening interval L1, and checks for information received from the BS (S120).

In this instance, the BS receives a unit of a data block which is exchanged between two objects in a specific level of a protocol with respect to another mobile
station, and is subdivided, i.e. a protocol data unit (PDU), and the BS transmits a mobile traffic indication (MOB_TRF_IND) message. In this instance, when a parameter in the MOB_TRF_IND message is negative (S130), the MS is changed into the sleep mode again. In this instance, a sleep interval is 2 * N1 frames corresponding to a double of a previous sleep interval. The 2 * N1 frames are counted at a point in which the sleep interval finally ends. Specifically, when a parameter in the MOB_TRF_IND message is negative, the sleep interval continuously increases until the sleep interval reaches Max Sleeping interval N2 by continuously doubling Max sleeping interval N2. However, when a parameter in the MOB_TRF_IND message is positive, the MS does not enter a sleep mode, and becomes a listening mode of a normal operation state (S140).

Accordingly, there is a problem that a WiBro standard communication method dependant on the BS does not effectively cope with a weak electromagnetic field or a communication environment in which electromagnetic waves are significantly varied. Specifically, when a WiBro terminal is in a state in which a channel environment is suddenly deteriorated, it is required to retrieve the BS at quicker sleep intervals, however, the BS may not be retrieved at quicker sleep intervals according to a conventional WiBro standard.

Therefore, a WiBro terminal and a method of determining a sleep mode of a WiBro terminal, which can measure a strength of a preamble signal in a listening mode, independently control a sleep mode operation, resulting from the comparing the strength with a threshold value, and perform a normal operation according to a predetermined indication signal, are required.

Disclosure of Invention
Technical Goals

The present invention provides a method of determining a sleep mode of a wireless broadband Internet (WiBro) terminal, in which a WiBro terminal can actively use a strength of a preamble signal transmitted from a base station, and control a sleep interval.

The present invention also provides a WiBro terminal, which can provide a stable data service even in a weak electromagnetic field or a field having a bad
communication environment.

Technical solutions

According to an aspect of the present invention, there is provided a method of determining a sleep mode of a wireless broadband Internet (WiBro) terminal, the method including: operating in a sleep mode during an N1 frame in which N1 indicates a natural number; operating in a listening mode during an L frame in which L indicates a natural number, after the operating in the sleep mode; measuring a strength of a preamble signal in the listening mode, and comparing the strength with a threshold value; controlling either a sleep mode operation during the N1 frame, or a sleep mode operation during two N1 frames, resulting from the comparing; and performing a normal operation according to a predetermined indication signal received from a base station, wherein the threshold value is determined based on an average of the preamble signals measured in a plurality of listening modes.

According to another aspect of the present invention, there is provided a WiBro terminal including: a modem which processes a transceiving packet according to a WiBro communication protocol; and a controlling unit which controls a sleep mode, based on a preamble signal extracted from the modem, wherein the controlling unit controls the WiBro terminal to operate in a listening mode during an L frame in which L indicates a natural number, after a sleep mode operation during an N1 frame in which N1 indicates a natural number, measures a strength of the preamble signal in the listening mode, compares the strength with a threshold value, controls either a sleep mode operation during the N1 frame, or a sleep mode operation during two N1 frames, resulting from the comparing, and controls a normal operation according to a predetermined indication signal which is generated and processed in the modem, and the threshold value is determined based on an average of the preamble signals measured in a plurality of listening modes.

Brief Description of Drawings

FIG. 1 is a flowchart illustrating a method of determining a sleep mode in a WiBro terminal according to a conventional art;

FIG. 2 is a flowchart illustrating a method of determining a sleep mode of a
WiBro terminal according to an exemplary embodiment of the present invention;

FIG. 3 is a diagram illustrating a WiBro system according to an exemplary embodiment of the present invention; and

FIG. 4 is a block diagram illustrating an internal structure of a WiBro terminal according to an exemplary embodiment of the present invention.

Best Mode for Carrying Out the Invention

Reference will now be made in detail to embodiments of the present invention, examples of which are illustrated in the accompanying drawings, wherein like reference numerals refer to the like elements throughout. The embodiments are described below in order to explain the present invention by referring to the figures.

FIG. 2 is a flowchart illustrating a method of determining a sleep mode of a WiBro terminal according to an exemplary embodiment of the present invention.

First, a WiBro terminal operates in a sleep mode during any N1 frame (S210). Next, the WiBro terminal enters an awake mode during an L frame, and operates in a listening mode (S220). The WiBro terminal enters an awake mode during an L frame in a listening mode, and measures a strength of a preamble signal in each frame (S230). Here, it is desirable that N1 and L indicate natural numbers.

When the strength of the preamble signal is measured, the WiBro terminal may be changed into a specific mode according to a predetermined condition, and may be divided into (A) an operation in which the WiBro terminal operates in the sleep mode during an N1 frame again (S240), (B) an operation in which the WiBro terminal operates in the sleep mode during 2 * N1 frames again (S250), and (C) performing a normal operation in which the WiBro terminal exits the sleep mode, and transceives a data packet with a base station (S260).

Specifically, as illustrated in FIG. 2, the WiBro terminal operates in a sleep mode during an N1 frame (S210), and operates in the awake mode during an L frame (S220). Also, the WiBro terminal measures a strength of a preamble signal in the listening mode during the L frame (S230), and compares the measured strength with a specific threshold value TH1, and determines a sleep interval of a next operation (S240). The strength of the preamble signal, measured in the listening mode, may correspond to an average value of preamble signals during the L frame in order to compare the
strength with the specific threshold value THl.

In this instance, the threshold value THl is not a fixed, predetermined value, and may be varied according to an environment of a channel, and the like. Also, the threshold value THl may be updated, be stored, and be managed in a predetermined memory of the WiBro terminal. Specifically, the threshold value THl may be constantly varied according to an environment of a channel, or may be determined based on a value averaging, during a regular interval, signal strengths of previous preambles. For example, the threshold value THl may be determined based on a value averaging, during 5L frames, signal strengths of preambles measured in previous listening modes. In this instance, the determined and updated threshold value may become less than or greater than the previous threshold value, however, the present invention controls a sleep interval in order to cope with a bad electromagnetic environment according to the updated threshold value more quickly than existing inventions, so as not to significantly increase a sleep interval, and so as to maintain a high-quality data service. The threshold value THl which may be varied according to an environment of a communication channel may be stored in the predetermined memory each time when updating, and may be used only when necessary.

When a radio wave environment using the WiBro terminal is suddenly deteriorated, and the strength of the preamble signal, measured in the listening mode, becomes less than the threshold value THl, maintaining the previous sleep interval (for example, an N1 frame) rather than continuously increasing the sleep interval is a method of effectively, actively, and quickly coping with a state in which an environment of a channel around a terminal is suddenly deteriorated, and maintaining a high-quality data service. Also, the WiBro terminal receives a MOB_TRF_IND message from the base station, and performs a next operation according to the MOB_TRF_IND message.

Specifically, when the strength of the preamble signal, measured in the listening mode during the L frame, is less than the threshold value THl, and MOB_TRF_IND is negative, the WiBro terminal maintains a sleep mode during an N1 frame (S240), and when the strength of the preamble signal, measured in the listening mode during the L frame, is greater than or equal to the threshold value THl, and MOB_TRF_IND is negative, the WiBro terminal maintains a sleep mode during 2 * N1 frames (S250). Also, when MOB_TRF_IND is positive, the WiBro terminal performs a normal
operation (S260).

Also, the threshold value THl enables a value, which is constantly updated each time in which the strength of the preamble signal is compared with the threshold value THl, to be applied. Also, the updated value may control a sleep interval of the WiBro terminal more effectively, based on a value, which averages values with respect to a previous radio wave environment, and is determined based on an average value, similar to the description above. Also, since preamble signals, measured in the listening mode in order to determine the threshold value THl, may be designated as preamble signals during 5L frames, the WiBro terminal may measure the strength of the preamble signal during the designated 5L frames, and determine the threshold value THl based on the value, thereby performing (A), (B), and (C) operations described above.

A method of determining a sleep mode of a WiBro terminal according to the above-described embodiment of the present invention may be recorded in computer-readable media including program instructions to implement various operations embodied by a computer. The media may also include, alone or in combination with the program instructions, data files, data structures, and the like. The media and program instructions may be those specially designed and constructed for the purposes of the present invention, or they may be of the kind well-known and available to those having skill in the computer software arts. Examples of computer-readable media include magnetic media such as hard disks, floppy disks, and magnetic tape; optical media such as CD ROM disks and DVD; magneto-optical media such as optical disks; and hardware devices that are specially configured to store and perform program instructions, such as read-only memory (ROM), random access memory (RAM), flash memory, and the like. The media may also be a transmission medium such as optical or metallic lines, wave guides, and the like, including a carrier wave transmitting signals specifying the program instructions, data structures, and the like. Examples of program instructions include both machine code, such as produced by a compiler, and files containing higher level code that may be executed by the computer using an interpreter. The described hardware devices may be configured to act as one or more software modules in order to perform the operations of the above-described embodiments of the present invention.
FIG. 3 is a diagram illustrating a WiBro system according to an exemplary embodiment of the present invention.

As illustrated in FIG. 3, a WiBro system 300 includes a WiBro terminal 400, a network 320, and a base station 330.

The WiBro terminal 400 is a communication terminal performing a WiBro function, and may receive various request messages, response messages, command messages, and the like from the base station 330. A WiBro indicates a wireless broadband Internet service technology which may be easily used while wireless mobile, e.g. a mobile communication terminal. When describing an example of the currently used WiBro, the WiBro uses a frequency of a band 2.3 GHz, supports mobility at speeds greater than 60 km/h, has a transmission speed corresponding to about 1 Mbps, and a transmission distance of the WiBro corresponds to maximum 48 km. Accordingly, there is an advantage that a service radius is wider than a wireless local area network (WLAN) used for only a service area referred to as "hot spot", and Wireless-Fidelity (Wi-Fi) by over ten times. Also, the WiBro is a communication technology having a compatibility with a World Interoperability for Microwave Access (WiMAX) corresponding to a WiBro service which is currently performed by Intel, combining with a Voice over Internet Protocol (VoIP) technology, and replacing a current Code Division Multiple Access (CDMA) mobile communication. The WiBro conforms to an international technology standard conforming to a next generation wireless broadband transmission technology standard which the Institute of Electrical and Electronics Engineers (IEEE) approves, i.e. IEEE 802.16e. The international technology standard is a WiBro technology standard, i.e. High-speed Portable Internet (HPi). A more detailed operation of the WiBro terminal 400 is described with reference to FIG. 4, as follows.

The network 320 indicates a communication network connecting between a mobile communication terminal and a fixed point, or between mobile communication terminals for each other, and various mobile communication principles such as a cellular mobile communication method, and the like, may be applied. Also, a base station (BS) relaying a transceiving radio wave of the WiBro terminal 400 as a wireless station which communicates with a portable electrical and electronic device, a gateway which is used for a function unit or an apparatus connecting with a same or different type
plurality of communication networks for each other, and transceiving information between communication networks, and the like.

The BS 330 is a wireless station which relays a transceiving radio wave of the WiBro terminal 400, is land based, and is immovable in order to perform a communication with a land mobile station, or a communication by relay of a mobile relay station as a wireless station for communicating with a portable electrical and electronic device. The BS 330 may include a base station system corresponding to a system configuring a base station in a mobile communication, and the base station system is divided into a Base Station Controller (BSC) and Base Transceiver Station (BTS). Also, the BSC performs a connection with various wired networks and a control of the BTS, and the BTS performs a wireless transmission with a mobile station. Also, the BS 330 according to the present invention may be a base station corresponding to a cell radius to which the WiBro terminal 400 belongs, or a plurality of base stations related to the WiBro terminal 400.

FIG. 4 is a block diagram illustrating an internal structure of a WiBro terminal according to an exemplary embodiment of the present invention.

As illustrated in FIG. 4, the WiBro terminal 400 includes a modem 410, a controlling unit 420, a wireless transceiver 430, an input unit 440, and an output unit 450.

The modem 410 changes an analog signal received via the wireless transceiver 430 into a digital signal (demodulation), or changes a digital signal from the WiBro terminal 400 into an analog signal to transmit the digital signal. Also, the present invention processes a transceiving packet according to a WiBro communication protocol.

The controlling unit 420 controls a sleep mode, based on a preamble signal extracted from the modem 410. Also, the controlling unit 420 controls the WiBro terminal to operate in a listening mode during an L frame, after a sleep mode operation during an N1 frame, measures a strength of the preamble signal in the listening mode when MOB_TRF_IND is negative, and compares the strength with a threshold value THl. Similar to the description above, the strength of the preamble signal, measured in the listening mode, may be an average value of preamble signals during the L frame, and the threshold value THl is determined based on a value averaging signal strengths of preambles during 5L frames measured in previous listening modes. The controlling
unit 420 controls either a sleep mode operation during the N1 frame, or a sleep mode operation during two N1 frames, resulting from the comparing. Also, the controlling unit 420 controls a normal operation when MOB_TRF_IND is positive. The MOB_TRF_IND message received from the base station may be included in the preamble signal, and may be processed in the modem 410. Accordingly, whether MOB_TRF_IND is positive or negative may be determined.

The controlling unit 420 performs overall control of each component of the WiBro terminal 400. Also, the controlling unit 420 generally includes a process function of processing all data in a communication terminal related to a modem Digital Signal Processor (DSP). The greater the number of DSPs for processing an internal signal such as a baseband signal and the like is, the more quickly an operation according to each mode is processed due to a quick process speed. The controlling unit 420 may use a Mobile Station Modem (MSM), a Digital Signal Processor (DSP), an Open Multimedia Application Platform (OMAP), and the like.

The wireless transceiver 430 performs a mobile communication service transceiving a radio wave with the base station, or transmits messages such as the MOB_SLP_REQ message, and the like according to the present invention to the BS 330, or receives messages such as the MOB_TRF_IND message, and the like from the BS 330.

The input unit 440 issues various commands to the WiBro terminal 400 or makes an establishment in the WiBro terminal 400. Also, at least one selected from the group consisting of a keypad, a touchscreen, a touchpad, a voice recognition module, and the like may be used for the input unit 440.

The output unit 450 is used for establishment of the WiBro terminal 400, or checking specific information. Also, at least one output unit from among an image output unit, an audio output unit, and a tactual output unit may be used for the output unit 450. The image output unit includes a liquid crystal display (LCD) included in the WiBro terminal 400, an organic light-emitting diode (LED), Plasma Display Panel (PDP), LED, and the like. Also, the audio output unit includes a speaker, an earphone, and the like, which may output various music such as a bell sound, a coloring, a Moving Picture Experts Group Audio Layer 3 (MP3) recording, and the like. Also, the tactual output unit uses a vibration motor, and the like.
Also, the WiBro terminal 400 is a portable electrical and electronic device. A portable device as used in the present specification includes mobile communication devices including a communication function, such as a Personal Digital Cellular (PDC) phone, a personal communication service (PCS) phone, a personal handyphone system (PHS) phone, a CDMA-2000 (IX, 3X) phone, a Wideband CDMA phone, a dual band/dual mode phone, a global system for mobile communication (GSM) phone, a mobile broadband system (MBS) phone, a Digital Multimedia Broadcasting (DMB) phone, a smart phone, and a cellular phone which perform a WiBro function described in the present invention; portable terminals such as a public switched telephone network (PSTN) terminal, a voice over Internet protocol (VoIP) terminal, a session initiation protocol (SIP) terminal, a media gateway control protocol (MGCP) terminal, a media gateway control (Megaco) terminal, a personal digital assistant (PDA), a hand-held PC, a notebook computer, a laptop computer, an MP3 player, and a mini disc (MD) player; and all types of hand-held based wireless communication devices including an International Mobile Telecommunication (IMT)-2000 terminal providing international roaming service and extended mobile communication service, and a Universal Mobile Telecommunication Service (UMTS) based terminal. Also, the portable device may include a predetermined communication module such as a CDMA module, a Bluetooth module, an Infrared Data Association (IrDA) module, a wired/wireless LAN card and a wireless communication device which is provided with a global positioning system (GPS) chip enabling tracking of a position via a GPS. Also, the portable device may include a microprocessor which can replay multimedia and perform a certain calculation operation.

Since a WiBro terminal for determining a sleep mode according to the present invention is described above, and contents described in exemplary embodiments in FIG. 2 may be applied to the present exemplary embodiment, hereinafter, a detailed description thereof is omitted.

Although a few embodiments of the present invention have been shown and described, the present invention is not limited to the described embodiments. Instead, it would be appreciated by those skilled in the art that changes may be made to these embodiments without departing from the principles and spirit of the invention, the scope of which is defined by the claims and their equivalents.
The foregoing descriptions of specific embodiments of the present invention have been presented for purposes of illustration and description. They are not intended to be exhaustive or to limit the invention to the precise forms disclosed, and obviously many modifications and variations are possible in light of the above teaching. Therefore, it is intended that the scope of the invention be defined by the claims appended thereto and their equivalents.

According to an aspect of the present invention, there is provided a method of determining a sleep mode of a WiBro terminal, in which a WiBro terminal can actively use a strength of a preamble signal transmitted from a base station, and control a sleep interval, thereby effectively, actively, and quickly providing a stable data service even in a weak electromagnetic field or a field having a bad communication environment and reducing a battery consumption amount using a short sleep interval.
CLAIMS

1. A method of determining a sleep mode of a wireless broadband Internet (WiBro) terminal, the method comprising:
   
   operating in a sleep mode during an N1 frame in which N1 indicates a natural number;

   operating in a listening mode during an L frame in which L indicates a natural number, after the operating in the sleep mode;

   measuring a strength of a preamble signal in the listening mode, and comparing the strength with a threshold value;

   controlling either a sleep mode operation during the N1 frame, or a sleep mode operation during two N1 frames, resulting from the comparing; and

   performing a normal operation according to a predetermined indication signal received from a base station,

   wherein the threshold value is determined based on an average of the preamble signals measured in a plurality of listening modes.

2. The method of claim 1, wherein the sleep mode operation during the N1 frame is performed when the strength of the preamble signal, measured in the listening mode, is less than the threshold value, resulting from the comparing, and

   the sleep mode operation during the two N1 frames is performed when the strength of the preamble signal, measured in the listening mode, is greater than or equal to the threshold value, resulting from the comparing.

3. The method of claim 1, wherein the strength of the preamble signal, measured in the listening mode, corresponds to an average value of preamble signals during the L frame.

4. The method of claim 1, wherein the threshold value may be varied according to an environment of a communication channel, or may be determined based on a value averaging, during a regular interval, signal strengths of previous preambles, and may be managed in a predetermined memory.
5. The method of claim 4, wherein the regular interval corresponds to a 5L frame of previous listening modes.

6. A computer-readable recording medium storing a program for implementing the method according to any one of claims 1 through 5.

7. A WiBro terminal comprising:
   a modem which processes a transceiving packet according to a WiBro communication protocol; and
   a controlling unit which controls a sleep mode, based on a preamble signal extracted from the modem,
   wherein the controlling unit controls the WiBro terminal to operate in a listening mode during an L frame in which L indicates a natural number, after a sleep mode operation during an N1 frame in which N1 indicates a natural number, measures a strength of the preamble signal in the listening mode, compares the strength with a threshold value, controls either a sleep mode operation during the N1 frame, or a sleep mode operation during two N1 frames, resulting from the comparing, and controls a normal operation according to a predetermined indication signal which is generated and processed in the modem, and
   the threshold value is determined based on an average of the preamble signals measured in a plurality of listening modes.

8. The WiBro terminal of claim 7, wherein the threshold value may be varied according to an environment of a communication channel, or may be determined based on a value averaging, during a regular interval, signal strengths of previous preambles, and may be managed in a predetermined memory.

9. The WiBro terminal of claim 8, wherein the regular interval corresponds to a 5L frame of previous listening modes.
FIG. 1

MOB-SLP-REQ
(MIN-SLEEPING INTERVAL=N1)
(MAX-SLEEPING INTERVAL=N2)
LISTENING INTERVAL=L1)

MOB-SLP-RSP
(START TIME=M)
(MIN-SLEEPING INTERVAL=N1)
(MAX-SLEEPING INTERVAL=N2)
LISTENING INTERVAL=L1)

S110

S120

S130

MOB-TRF-IND
(NEGATIVE INDICATION)

S140

MOB-TRF-IND
(POSITIVE INDICATION)

PDU FOR THE MS

LSB OF FRAME NUMBER=M

SLEEP MODE FOR N1 FRAMES

LISTENING FOR L' FRAMES

SLEEP MODE FOR 2^N1 FRAMES

LISTENING FOR L' FRAMES

SLEEP MODE FOR 4^N1 FRAMES
NORMAL OPERATION

MS

BS
FIG. 2

A

STRENGTH OF PREAMBLE SIGNAL IS LESS THAN SPECIFIC THRESHOLD VALUE TH1, AND MOB.TRF.IND IS NEGATIVE

S240

SLEEP FOR N1 FRAMES

B

CHECK THE LEVEL OF PREAMBLE

S230

STRENGTH OF PREAMBLE SIGNAL IS GREATER THAN OR EQUAL TO SPECIFIC THRESHOLD VALUE TH1, AND MOB.TRF.IND IS NEGATIVE

S250

SLEEP FOR 2*N1 FRAMES

C

MOB.TRF.IND IS POSITIVE

S260

NORMAL OPERATION
FIG. 4

400

WIRELESS TRANSCEIVER

RX

TX

420

430

440

CONTROLLING UNIT

INPUT UNIT

KEYPAD

OUTPUT UNIT

IMAGE OUTPUT UNIT

AUDIO OUTPUT UNIT

MODEM

410

450
INTERNATIONAL SEARCH REPORT

PCT/KR2006/005869

A. CLASSIFICATION OF SUBJECT MATTER

H04B 7/26(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC8 H04B 7, H04L 12, H04Q 7

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

KOREAN UTILITY MODELS AND APPLICATIONS FOR UTILITY MODELS SINCE 1975

JAPANESE UTILITY MODELS AND APPLICATIONS FOR UTILITY MODELS SINCE 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKIPASS, DELPHION, ESPACENET & Keywords IEEE 802 16e, WIBRO, WIMAX, sleep, listen, frame, preamble and similar terms

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<th>Category</th>
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Further documents are listed in the continuation of Box C

See patent family annex

* Special categories of cited documents
  "A" document defining the general state of the art which is not considered to be of particular relevance
  "E" earlier application or patent but published on or after the international filing date
  "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
  "O" document referring to an oral disclosure, use, exhibition or other means
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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance, the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance, the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
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Date of the actual completion of the international search

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Date of mailing of the international search report

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