

METHOD FOR SEARCHING FOR A USEFUL SIGNAL IN A MULTIPLEXING BAND

Background

5 The present invention belongs to the field of digital telecommunications, and more specifically relates to the search for the presence of a useful signal of predefined spectral width ΔB in a shared frequency band having a spectral width larger than ΔB .

State of the art

10 In digital telecommunications systems, it is known to use a same frequency band, called "multiplexing band", for transmissions of useful signals from terminals to a station.

Generally, the useful signals have the same spectral width, and said spectral width is known beforehand by the station. It is also possible, in certain cases, to have a plurality of possible spectral widths, all being known beforehand by the station.

15 Further, the central frequencies around which useful signals can be transmitted are, in the most general case, also predefined and known beforehand by the station. Thereby, the search for the presence of a useful signal transmitted in the multiplexing band may be limited to a power detection on each of the possible central frequencies.

There however exist cases where the central transmit frequencies of useful signals are not known in advance.

20 For example, the international PCT application published under number WO 2011/154466 describes a narrow band digital telecommunications system where spectral width ΔB of the useful signals is in the range from a few hertz to a few hundreds of hertz.

Further, to ensure a forced statistical frequency division multiple access (FSFDMA), the frequency drift of said useful signals is greater than spectral width ΔB .

25 It can thus be understood that in such a case, it is not possible to know in advance the central frequencies around which useful signals are likely to be received by the digital telecommunications system station. Thus, the search for the presence of a useful signal in the multiplexing band should be performed in the entire multiplexing band, and should accordingly be accompanied by a search for the central frequency (at least initial, if it
30 varies along time) around which a useful signal is received by the station.

Such a joint presence and central frequency search may be complex to achieve, in particular if the multiplexing band is significantly larger than spectral width ΔB of the useful signals.

Summary

The present invention aims at overcoming all or part of the limitations of prior art solutions, particularly those discussed hereabove, by providing a solution which enables to search for the presence of a useful signal having a central frequency which is not
5 known beforehand in a multiplexing band, in simple and robust fashion.

Further, the invention also aims at providing a solution which enables, at least in certain embodiments, to only detect useful signals capable of being decoded with no errors.

For this purpose, and according to a first aspect, the invention relates to a method of
10 searching for the presence of a useful signal in a general signal, said useful signal corresponding to a radioelectric signal having a predefined spectral width ΔB transmitted by a terminal in a multiplexing band having a spectral width greater than ΔB , the general signal corresponding to all the radioelectric signals received in the multiplexing band. The search method comprises steps of:

- 15 - calculating a frequency signal representative of a power spectral density of the general signal sampled at elementary frequencies of the multiplexing band,
- calculating a signal, called "non-useful signal", by filtering the frequency signal by means of a filter capable of mainly suppressing all or part of signals having a spectral width equal to or smaller than ΔB in said frequency signal,
- 20 - calculating a signal, called "power ratio signal", representative of the ratio, at each elementary frequency, of the frequency signal to the non-useful signal,
- comparing the power ratio signal with a predefined threshold value, an elementary frequency for which said power ratio signal has a local maximum value greater than said threshold value being considered as being the central frequency of a useful signal present
25 in the general signal.

Such a search method is relatively simple to implement, since it requires few operations after the frequency signal has been obtained. In particular, the filter used to calculate the non-useful signal may be a simple finite impulse response filter.

It should further be noted that the filter used to calculate the non-useful signal is a
30 frequency filter, that is, it performs, in the frequency field, a linear combination of different samples of the frequency signal corresponding to different elementary frequencies.

Accordingly, the application of this frequency filter introduces no other delay than that corresponding to the necessary calculation time of the convolution, and only intro-

duces a frequency shift which can easily be compensated for. Thus, the search method, by the use of a frequency filter, enables to rapidly detect useful signals in the general signal, while the use of a time filter, applied to samples obtained for different consecutive times, would necessarily introduce a delay depending on the order of said time filter.

5 Such a search method is further robust since it uses, to determine whether a useful signal is present in the general signal, a power ratio signal which is representative of the signal-to-noise/interference ratio that a useful signal would have at each elementary frequency.

10 Indeed, the non-useful signal is representative, at each elementary frequency, of the power received on this elementary frequency, the signals of spectral width equal to or smaller than ΔB (and accordingly all the useful signals possibly present in the general signal) having been previously suppressed.

15 The frequency signal is representative, at each elementary frequency, of the entire power received on this elementary frequency, which corresponds to the power of the non-useful signal on this elementary frequency, possibly cumulated with the power of a useful signal present on this elementary frequency.

In specific embodiments, the search method comprises one or a plurality of the following features, taken separately or according to all technically-possible combinations.

20 In a specific embodiment, where the elementary frequencies are separated by a sampling interval Δb smaller than ΔB , the method comprises a step of calculating a signal, called "averaged signal", by averaging the frequency signal with a sliding window on the elementary frequencies, the sliding window having a width substantially equal to ΔB . In this case, the non-useful signal is calculated by filtering the averaged signal, and the power ratio signal is calculated as being representative of the ratio, at each elementary
25 frequency, of the averaged signal to the non-useful signal.

Due to this averaging, the power, in each band substantially of spectral width ΔB , is concentrated around the elementary frequency substantially located at the center of the band substantially of bandwidth ΔB . Thereby, the detection of useful signals is improved, in particularly due to the fact that, in the presence of a useful signal, the averaged signal
30 will have a local maximum value at the level of the elementary frequency closest to the real central frequency of said useful signal, while this is not necessarily true in the frequency signal.

Further, it is advantageous to consider a sampling interval Δb much smaller than ΔB (for example, smaller than $\Delta B/4$), particularly to improve the accuracy of the central frequencies of the useful signals. The power concentration is then all the more advantageous as the power of a useful signal is then distributed over a plurality of adjacent samples of the frequency signal.

In a specific embodiment, the threshold value is previously determined as being a value of the power ratio signal above which the probability to decode a useful signal with errors is lower than 5%, preferably lower than 1%.

"Probability of decoding a useful signal with errors" means the probability of having, at the level of the physical layer, at least one false bit among the bits obtained after demodulation of the symbols (BPSK, DBPSK, QPSK, 16QAM, etc.) and after channel decoding if a channel coding has been performed by the terminal having transmitted the useful signal.

Such a threshold value selection for the power ratio signal is particularly advantageous in that it enables to limit the detection to useful signals capable of being decoded with no error with a high probability. Such a threshold value selection is possible due to the fact that the power ratio signal is representative of the signal-to-noise/interference ratio that a useful signal would have at each elementary frequency, so that an adapted threshold value can be previously defined, for example by simulation.

It should be noted that such a criterion of low probability of decoding a useful signal with errors is very different from a criterion of high probability of detection. Indeed, in this specific embodiment, only useful signals for which it is almost ensured to have an error-free decoding are detected. Thus, useful signals will not be detected if the probability of decoding them with errors is too high, whereby the detection probability may be low.

Such an embodiment is preferably aimed at digital telecommunications systems which can tolerate a low-performance detection probability, for example due to the fact that a same useful signal is retransmitted a plurality of times by each terminal.

As a counterpart, such a search method enables to optimize the use of the calculation capacity of a station intended to decode useful signals, since said calculation capacity is mainly used for the processing of useful signals sufficiently powerful to be decoded.

According to a second aspect, the invention relates to a computer program product comprising a set of program code instructions which, when they are executed by one or a

plurality of processors, implement a method of searching for the presence of a useful signal in a general signal according to the invention.

According to a third aspect, the invention relates to a unit for receiving a useful signal corresponding to a radioelectric signal of predefined spectral width ΔB transmitted by a terminal in a multiplexing band having a spectral width greater than ΔB , said receiver unit comprising means configured to search for the presence of a useful signal in the multiplexing band in accordance with a method according to the invention.

According to a fourth aspect, the invention relates to a station of a digital telecommunications system, said station comprising a receiver unit according to the invention.

10 **Description of the drawings**

The invention will be better understood on reading of the following description, given as a non-limiting example, in relation with the drawings, which show:

- Figure 1: a simplified representation of a digital telecommunications system,
- Figure 2: a diagram illustrating the main steps of a useful signal search method,
- 15 - Figure 3a to 3d: examples of frequency signals obtained at the output of steps of the search method of Figure 2.

In these drawings, identical references from one drawing to another designate identical or similar elements. For clarity, the shown elements are not to scale, unless otherwise mentioned.

20 **Detailed discussion of embodiments**

Figure 1 very schematically shows a telecommunications system 10 comprising a plurality of terminals 20 and a station 30.

In the context of the invention, "station" generally means any receiver device capable of receiving radioelectric signals. Station 30 is for example any of terminals 20, or a specific device such as an access point of a wired or wireless telecommunications network, centralizing the data transmitted by each of said terminals 20.

"Radioelectric signal" means an electromagnetic wave propagating via wireless means, having frequencies in the conventional spectrum of radioelectric waves (from a few hertz to several hundreds of gigahertz) or in neighboring frequency bands.

30 It should be noted that the case of a data transmission from terminals 20 to station 30 is mainly considered. The possible transmission of data from station 30 to terminals 20 is not comprised within the scope of the invention.

Terminals 20 transmit useful signals to station 30 in a shared frequency band, called "multiplexing band", having a spectral width ΔM .

The useful signals transmitted by terminals 20 have a predefined spectral width ΔB smaller than ΔM . Preferably, spectral width ΔM of the multiplexing band is significantly greater than spectral width ΔB of the useful signals, to be able to multiplex a large number of terminals 20. For example, spectral width ΔM is at least one hundred times greater than spectral width ΔB .

Spectral widths ΔB and ΔM are both known beforehand by station 30. However, the central frequency around which a terminal 20 transmits a useful signal is not necessarily known beforehand by station 30. This is for example true, as previously indicated, when the frequency drift of the useful signals is greater than spectral width ΔB of said useful signals (see international application WO 2011/154466).

The following description considers, without this being a limitation, a digital telecommunications system such as described in international application WO 2011/154466, where the useful signals have a narrow band (spectral width ΔB in the range from a few hertz to a few hundreds of hertz) and the frequency drift of said useful signals is greater than spectral width ΔB .

It should further be noted that spectral width ΔB of the useful signals corresponds to the instantaneous spectral width of said useful signals. It should indeed be understood that the frequencies successively taken over time by a useful signal should correspond to a frequency band having a width greater than ΔB , particularly due to the frequency drift of said useful signal.

Accordingly, station 30 should search for the presence of useful signal in the entire multiplexing band, jointly with a search for the central frequencies of the useful signals present in said multiplexing band.

For this purpose, station 30 particularly comprises a receiver unit capable of receiving a general signal corresponding to all the radioelectric signals received in the multiplexing band.

The receiver unit comprises an analog receiver module and a digital receiver module.

The analog receiver module comprises a set of means, considered as known by those skilled in the art (antennas, analog filters, amplifiers, local oscillators, mixers, etc.), capable of shifting the frequency of the general signal.

The analog receiver unit outputs an analog signal corresponding to the general signal shifted around an intermediate frequency lower than the central frequency of the multiplexing band, and which may be zero (in which case two analog signals are provided, corresponding in known fashion to the paths in phase I and in quadrature Q).

5 The digital receiver module comprises, in known fashion, one or a plurality of analog-to-digital converters (A/D) capable of sampling the analog signal(s) delivered by the analog receiver module, with a predefined sampling period, to obtain a digital signal S_t representative of the analog signal(s).

10 The digital receiver module further comprises a unit for processing the digital signal at the output of the A/D converters. The processing unit particularly executes, based on the digital signal, the steps of a method 50 of searching for the presence of a useful signal in the general signal, described in further detail hereafter.

The processing unit for example comprises a processor and an electronic memory having a computer program product stored therein, in the form of a set of program code 15 instructions which, when they are executed by the processor, implement all or part of the steps of a method 50 of searching for the presence of a useful signal according to the invention. In a variation, the processing unit comprises programmable logic circuits, of FPGA, PLD, etc., type and/or application-specific integrated circuits (ASICs), capable of implementing all or part of the steps of said search method 50.

20 Figure 2 shows the main steps of a method 50 of searching for the presence of a useful signal transmitted by a terminal 20 in the multiplexing band, which are:

- 51 calculating a frequency signal S_f ,
- 54 calculating a signal, called "non-useful signal" S_{nu} ,
- 56 calculating a signal, called "power ratio signal" S_{rp} ,
- 25 - 57 comparing power ratio signal S_{rp} with a predefined threshold value.

In the embodiment illustrated in Figure 2, search method 50 also comprises, in addition to the above main steps, optional steps which will be described hereafter.

Frequency signal S_f calculated during calculation step 51 is representative of a power spectral density of the general signal, said power spectral density being called 30 "PSD" hereafter.

More particularly, frequency signal S_f is formed of N samples $S_f(n)$ ($0 \leq n \leq N-1$) representative of the values taken by power spectral density PSD of the general signal at

elementary frequencies f_n ($0 \leq n \leq N-1$) regularly distributed in the multiplexing band with a sampling interval Δb assumed to be such that $N \cdot \Delta b = \Delta M$. In other words:

- $S_f = \{S_f(n), \text{ with } 0 \leq n \leq N-1\}$,
- $S_f(n) \sim \text{PSD}(f_n)$, " $\sim$ " meaning "representative of",
- 5 - $f_n = f_0 + n \cdot \Delta b$, with $0 \leq n \leq N-1$.

To accurately estimate the central frequency of a possible useful signal present in the general signal, sampling interval Δb is further selected to be smaller than spectral width ΔB of the useful signals. In preferred embodiments, sampling interval Δb is much smaller than spectral width ΔB , for example, smaller than $\Delta B/4$.

10 Figure 2 shows a specific embodiment of step 51 of calculating frequency signal S_f . In this embodiment, step 51 of calculating frequency signal S_f comprises sub-steps of:

- 510 calculating a fast Fourier transform (FFT) of digital signal S_t , which is a signal defined in the time domain,
- 511 calculating frequency signal S_f as being the modulus, at each elementary
- 15 frequency, of the result of the fast Fourier transform.

The power spectral density of digital signal S_t (representative of the general signal) is known to be obtained, at each elementary frequency, by calculating the square of the modulus of the result of the fast Fourier transform. Thus, frequency signal S_f is linked to power spectral density PSD of the general signal by the following expression:

$$S_f(n) = \sqrt{\text{PSD}(f_n)}$$

20 Figure 3a shows, in logarithmic scale, an example of power spectral density PSD of a general signal shifted to the baseband. In other words, Figure 3a shows the variation of function $20 \cdot \log(S_f(n))$ for elementary frequencies distributed in a frequency interval $[-\Delta M/2; \Delta M/2]$.

It should be noted that power spectral density PSD, in Figure 3a, comprises a line

25 centered on the zero frequency, which corresponds to an unwanted DC component, called "DC" in said Figure 3a. It is indeed known by those skilled in the art that the zero frequency is generally very disturbed, whereby it is most often ignored in the search for the presence of useful signals due to the fact that:

- the unwanted DC component risks leading to a false detection (that is, to errone-
- 30 ously considering that a useful signal, centered on the zero frequency, is present),
- even though a useful signal would be present and centered on the zero frequency, the probability of decoding it with no errors is low.

In the embodiment illustrated in Figure 2, search method 50 comprises a step 52 of calculating a signal, called "averaged signal" S_m . Averaged signal S_m calculated during step 52 is obtained by averaging of frequency signal S_f with a sliding window on elementary frequencies f_n ($0 \leq n \leq N-1$), said sliding window having a width substantially
 5 equal to spectral width ΔB of the useful signals.

This averaging of frequency signal S_f aims at concentrating the power, in each band substantially having a spectral width ΔB , around the elementary frequency substantially located at the center of the band substantially of frequency width ΔB . Thereby, in the presence of a useful signal, averaged signal S_m should theoretically comprise a local
 10 maximum value at the level of the elementary frequency closest to the real central frequency of said useful signal, while this is not necessarily true in frequency signal S_f .

Accordingly, averaged signal S_m is representative, at each elementary frequency, of the entire power received in a band of frequency width ΔB centered on this elementary frequency, which corresponds to the power of the non-useful signal in this band, possibly
 15 cumulated with the power of a useful signal present in this band.

Step 52 of calculating averaged signal S_m for example comprises calculating the following expression:

$$S_m(n) = \sum_{m=-M/2}^{M/2} h(m) \cdot S_f(n+m)$$

where:

- $h = \{h(m), \text{ with } -M/2 \leq m \leq M/2\}$ is the sliding window used for the averaging, M
 20 being an even integer,
- $S_f(n+m) = S_f(n+m)$ if $0 \leq n+m \leq N-1$
- $S_f(n+m) = 0$ if $n+m < 0$ or if $n+m > N-1$.

To have an averaging window of frequency width substantially equal to spectral width ΔB , M is for example selected to be such that $(M-2) \cdot \Delta b \leq \Delta B \leq (M+2) \cdot \Delta b$.

25 In a specific embodiment, the sliding window used is a simple rectangular window. In other words, $h(m) = 1/(M+1)$ with $-M/2 \leq m \leq M/2$. Nothing precludes, according to other examples, considering other types of sliding windows, possibly representative of weighted averages.

In the specific embodiment illustrated in Figure 2, search method 50 comprises a
 30 step 53 during which averaged signal S_m is converted to the logarithmic scale, by calculating a signal S_{log} :

$$\text{Slog}(n) = 20 \cdot \log(\text{Sm}(n)), \text{ with } 0 \leq n \leq N-1$$

Passing to a logarithmic scale is advantageous to enable to more simply calculate power ratio signal Srp .

Figure 3b shows a signal Slog obtained from the signal illustrated in Figure 3a. As
 5 illustrated in Figure 3b, the averaging shows local maximum values $R1$, $R2$, $R3$ capable of corresponding to useful signals, by a concentration of the power of the useful signals around their central frequency, but also by a decrease in the fluctuations of a power spectral density of noise present in frequency signal Sf .

In a specific embodiment illustrated in Figure 2, signal Slog originating from averaged signal Sm and representative of power spectral density DSP of the general signal is then delivered to two different processing branches:

- a first branch where non-useful signal Snu is calculated from signal Slog (calculation step 54)
- a second branch where a signal, called "shifted signal" Sd , is calculated from
 15 signal Slog .

In the first branch, non-useful signal Snu is calculated by filtering of signal Slog by means of a filter capable of suppressing all or part of signals having a spectral width equal to or smaller than ΔB .

Thus, step 54 of calculating non-useful signal Snu performs a low-pass filtering of
 20 the frequency variations of signal Slog in the multiplexing band. Indeed, the "fast" variations of signal Slog , which correspond to signals which occupy a narrow frequency band, will be more attenuated than "slow" frequency variations of signal Slog , which correspond to signals which occupy a wide frequency band.

The filter used during step 54 of calculating non-useful signal Snu is capable of
 25 strongly attenuating signals which occupy a frequency band equal to or smaller than ΔB , as compared with the signals occupying a frequency band greater than ΔB . The design of such a filter is considered as being within the abilities of those skilled in the art.

Due to the use of a filter having the above characteristics, it should be understood that, in the obtained non-useful signal Snu :

- 30 - the useful signals possibly present in the general signal (and thus in signal Slog) will be strongly attenuated,
- the noise, of substantially constant spectral density in the entire multiplexing band, will be lightly attenuated.

Accordingly, the filtering of signal Slog enables to obtain a non-useful signal Snu representative, at each elementary frequency, of the power received in a band of frequency width ΔB centered on this elementary frequency, the signals of spectral width equal to or smaller than ΔB (and accordingly all the useful signals possibly present in the
 5 general signal) having been previously suppressed. Non-useful signal Snu is thus representative of noise/interference present in the multiplexing band.

Accordingly, the filtering of signal Slog provides a non-useful signal Snu where the useful signals have been substantially suppressed.

Figure 3c shows a non-useful signal Snu obtained from signal Slog illustrated in
 10 Figure 3b. It can be observed that, due to the filtering, local maximum values R1, R2, and R3 have been strongly attenuated, while an average level of signal Slog in the multiplexing band has been lightly attenuated.

In the second branch, search method 50 comprises a step 55 during which signal Slog, originating from the averaged signal, is frequency-shifted, to obtain a shifted signal
 15 Sd having its frequency realigned with non-useful signal Snu.

Indeed, non-useful signal Snu exhibits, in known fashion, a frequency shift which is introduced by the frequency filtering and which depends on the order of the implemented frequency filter. The determination of the introduced frequency shift and its compensation are performed in a simple manner, by operations considered as being within the abilities
 20 of those skilled in the art.

Useful signal search method 50 then comprises step 56 of calculating power ratio signal Srp, said power ratio signal being representative, at each elementary frequency, of a ratio of the averaged signal Sm obtained for this elementary frequency to the non-useful signal Snu obtained for this elementary frequency.

25 In the example illustrated in Figure 2, the power ratio signal Srp is calculated from non-useful signal Snu and shifted signal Sd, which essentially corresponds to averaged signal Sm.

Due to the fact that non-useful signal Snu and shifted signal Sd are both in logarithmic scale, power ratio signal Srp is calculated by simply subtraction, at each
 30 elementary frequency, of non-useful signal Snu from shifted signal Sd:

$$Srp(n) = Sd(n) - Snu(n), \text{ with } 0 \leq n \leq N-1$$

Figure 3d shows a power ratio signal Srp obtained from the signals illustrated in Figures 3b and 3c.

Useful signal search method 50 then comprises step 57 of comparing power ratio signal S_{rp} with a predefined threshold value V_{min} . During this step, an elementary frequency for which said power ratio signal S_{rp} has a local maximum value greater than said threshold value V_{min} is considered as being the central frequency of a useful signal present in the general signal.

In the example illustrated in Figure 3d (where the unwanted DC component has been ignored), the considered threshold value V_{min} is substantially equal to 8 decibels (dB) and it can be observed that local maximum values R_1 , R_2 , and R_3 are all three greater than said threshold value V_{min} . Accordingly, these three local maximum values R_1 , R_2 , and R_3 are considered as corresponding to useful signals, and the elementary frequencies for which these local maximum values have been obtained are considered as being the respective central frequencies of these useful signals.

In a preferred embodiment, threshold value V_{min} is previously determined as being a value of power ratio signal S_{rp} above which the probability of decoding a detected useful signal with errors is lower than 5%, preferably lower than 1%.

Such a selection of threshold value V_{min} is advantageous since it enables to optimize the use of a calculation capacity of station 30, since said calculation capacity is mainly used to process useful signals which are sufficiently powerful to be decoded.

More generally, the scope of the present invention is not limited to the embodiments described hereabove as non-limiting examples.

In particular, nothing precludes, according to other examples, having step 53 of conversion to the logarithmic scale executed at a different location in search method 50, for example, executed on the one hand on non-useful signal S_{nu} and, on the other hand, on shifted signal S_d , just before step 56 of calculating power ratio signal S_{rp} .

Further, search method 50, in the above-described example, comprises two processing branches which take signal S_{log} as an input. These two processing branches could however take other signals as an input. According to a non-limiting example, the two branches may take frequency signal S_f as an input. In this case, the first branch (obtaining of non-useful signal S_{nu}) may perform the averaging of step 52 and the filtering of step 54, and possibly a conversion to the logarithmic scale. The second branch then performs the averaging of step 52 and possibly a conversion to the logarithmic scale. In this example, each processing branch thus comprises the averaging of step 52. In the first branch,

the averaging of step 52 and the filtering of step 54 may further be performed jointly with a single filter.

CLAIMS

1. A method (50) of searching for the presence of a useful signal in a general signal, said useful signal corresponding to a radioelectric signal having a predefined spectral width ΔB transmitted by a terminal in a multiplexing band having a spectral width greater than ΔB , said general signal corresponding to all the radioelectric signals received in the multiplexing band, characterized in that it comprises steps of:
 - (51) calculating a frequency signal representative of a power spectral density of the general signal sampled at elementary frequencies of the multiplexing band,
 - 10 - (54) calculating a signal, called "non-useful signal", by filtering of the frequency signal by means of a filter capable of suppressing all or part of signals having a spectral width equal to or smaller than ΔB ,
 - (56) calculating a signal, called "power ratio signal", representative of the ratio, at each elementary frequency, of the frequency signal to the non-useful signal,
 - 15 - (57) comparing the power ratio signal with a predefined threshold value, an elementary frequency for which said power ratio signal has a local maximum value greater than said threshold value being considered as being the central frequency of a useful signal present in the general signal.
2. The method (50) of claim 1, characterized in that the elementary frequencies being separated by a sampling interval Δb smaller than ΔB , said method comprises a step (52) of calculating a signal, called "averaged signal", by averaging the frequency signal with a sliding window on the elementary frequencies, the sliding window having a width substantially equal to ΔB , and:
 - the non-useful signal is calculated by filtering of the averaged signal,
 - 25 - the power ratio signal is calculated as being representative of the ratio, at each elementary frequency, of the averaged signal to the non-useful signal.
3. The method (50) of claim 2, characterized in that the sliding window considered during the step (52) of calculating the averaged signal is a rectangular window.
- 30 4. The method (50) of any of the foregoing claims, characterized in that the threshold value is previously determined as being a value of the power ratio signal above which the probability to decode a useful signal with errors is lower than 5%, preferably lower than 1%.

5. The method (50) of any of the foregoing claims, characterized in that the elementary frequencies are separated by a sampling interval Δb smaller than $\Delta B/4$.

6. A computer program product, characterized in that it comprises a set of program code instructions which, when they are executed by a processor, implement the
5 method (50) of searching for the presence of a useful signal in a general signal of any of the foregoing claims.

7. A unit for receiving a useful signal corresponding to a radioelectric signal of predefined spectral width ΔB transmitted by a terminal in a multiplexing band having a spectral width greater than ΔB , characterized in that said receive unit comprises means
10 configured to search for the presence of a useful signal in said multiplexing band in accordance with the method (50) of any of claims 1 to 5.

8. A station (30) of a digital telecommunications system (10), characterized in that it comprises the receiver unit of claim 7.

ABSTRACT**METHOD FOR SEARCHING FOR A USEFUL SIGNAL IN A MULTIPLEXING
BAND**

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The present invention relates to a method (50) of searching for the presence of a useful signal of predefined spectral width ΔB in a multiplexing band having a spectral width greater than ΔB , including steps of:

- (51) calculating a frequency signal representative of a power spectral density in the
10 multiplexing band,
- (54) calculating a non-useful signal by filtering the frequency signal by means of a filter capable of suppressing all or part of signals having a spectral width equal to or smaller than ΔB ,
- (56) calculating a power ratio signal representative of the ratio of the frequency signal to
15 the non-useful signal,
- (57) comparing the power ratio signal with a predefined threshold value.

The invention also relates to a computer program product, a receiver unit, and a station (30) of a digital telecommunications system (10) comprising such a receiver unit.

20 Figure 2