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Datasheet for the decision of 13 October 2011

Case Number: T 1075/08 - 3.5.02

Application Number: 00926884.8

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Language of the proceedings: EN

Title of invention:
Sample rate converter

Applicant:
NXP B.V.

Opponent:
-

Headword:
-

Relevant legal provisions:
EPC Art. 56

Relevant legal provisions (EPC 1973):
-

Keyword:
"Inventive step (no - all requests)"

Decisions cited:
-

Catchword:
-

Case Number: T 1075/08 - 3.5.02

D E C I S I O N
of the Technical Board of Appeal 3.5.02
of 13 October 2011

Appellant: (Applicant)
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 3 January 2008 refusing European patent application No. 00926884.8 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman: M. Ruggiu
Members: M. Rognoni
P. Mühlens

Summary of Facts and Submissions

I. The appellant (applicant) appealed against the decision of the examining division refusing European patent application No. 00 926 884.8.

II. In the contested decision, the examining division came, *inter alia*, to the conclusion that none of the applicant's requests involved an inventive step within the meaning of Article 56 EPC having regard to the following state of the art:

D1: US-A-5 274 372,

D2: R.E. Crochiere, L.R. Rabiner: "Multirate Digital Signal Processing", Prentice-Hall, Inc., Upper Saddle River, NJ, USA, 1983, pages 79 to 86 and 193 to 196.

III. With the statement of grounds of appeal dated 6 May 2008, the appellant filed a new main request and first, second, third, fourth and fifth auxiliary requests.

IV. In a communication dated 19 May 2011 summoning the appellant to oral proceedings, the Board referred additionally to the following state of the art:

D3: R.E. Crochiere and L.R. Rabiner: "Interpolation and Decimation of Digital Signals - A Tutorial Review", Proceedings of the IEEE, Vol. 69, No. 3, March 1981, pages 300 to 331,

D4: A. M. Böck, "Design Criteria for Video Sampling Rate Conversion Filters", Electronics Letters, 2nd August 1990, Vol. 26, No. 16, pages 1259 and 1260.

V. In reply to the Board's communication, the appellant filed with a letter dated 13 September 2011 amended first, second and third auxiliary requests.

VI. Oral proceedings were held before the Board on 13 October 2011.

VII. The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of claims 1 to 7 of the main request filed with letter of 6 May 2008 or, if that was not possible, on the basis of the claims of one of the first, second and third auxiliary requests filed with letter of 13 September 2011 or the claims of one of the fourth and fifth auxiliary requests filed with the letter of 6 May 2008.

VIII. Claim 1 according to the main request reads as follows:

"Flexible sample rate converter (FSRC1) comprising a series-arrangement of polyphase decomposition filter means (PDFM1) and interpolator means (IM1), whereby one side of the series-arrangement is coupled to an input (I1) of the flexible sample rate converter (FSRC1) for receiving an input signal with a first sampling frequency and the other side of the series-arrangement is coupled to an output (O1) for supplying an output signal with a second sampling frequency, and the flexible sample rate converter (FSRC1) comprises control means (CM1) for controlling the polyphase decomposition filter means (PDFM1) and the interpolation means (IM1), wherein filter-coefficients are chosen on the basis of a required suppression of mirror spectra and a necessary relative bandwidth."

Claims 2 to 7 are dependent on claim 1.

Claim 1 according to the first auxiliary request differs from claim 1 of the main request in that the last feature reads as follows:

"wherein filter-coefficients of the polyphase decomposition filter means are chosen on the basis of a required suppression of mirror spectra and a necessary relative bandwidth".

Claim 1 according to the second auxiliary request differs from claim 1 of the first auxiliary request in that it further comprises the following feature:

"and wherein the flexible sample rate converter (FSRC1) further comprises an auxiliary up-converter in front of the series-arrangement."

Claim 1 according to the third auxiliary request differs from claim 1 of the first auxiliary request in that it further comprises the following feature:

"and wherein the flexible sample rate converter (FSRC1) comprises an auxiliary up-converter with an up-conversion of at least two, whereby in operation the sampling frequency or frequencies used in the flexible sample rate converter (FSRC1) are lower than or equal to the highest frequency of the input and output sampling frequencies multiplied with the auxiliary up-conversion factor."

Claim 1 according to the fourth auxiliary request reads as follows:

"Flexible sample rate converter (FSRC1) comprising a series-arrangement of polyphase decomposition filter means (PDFM1) and interpolator means (IM1), whereby one side of the series-arrangement is coupled to an input (I1) of the flexible sample rate converter (FSRC1) for receiving an input signal with a first sampling frequency and the other side of the series-arrangement is coupled to an output (O1) for supplying an output signal with a second sampling frequency, and the flexible sample rate converter (FSRC1) comprises control means (CM1) for controlling the polyphase decomposition filter means (PDFM1) and the interpolation means (IM1), wherein the polyphase decomposition filter means (PDFM1) comprise polyphase branches (G128,0(z) - G128,127(z)), and the interpolation means (IM1) comprise switches (SW11, SW12) coupled to outputs of the polyphase branches (G128,0(z) - G128,127(z))."

Claim 1 according to the fifth auxiliary request reads as follows:

"Flexible sample rate converter (FSRC1) comprising a series-arrangement of polyphase decomposition filter means (PDFM1) and interpolator means (IM1), whereby one side of the series-arrangement is coupled to an input (I1) of the flexible sample rate converter (FSRC1) for receiving an input signal with a first sampling frequency and the other side of the series-arrangement is coupled to an output (O1) for supplying an output signal with a second sampling frequency, and the flexible sample rate converter (FSRC1) comprises control means (CM1) for controlling the polyphase decomposition filter means (PDFM1) and the interpolation means (IM1), wherein the polyphase decomposition filter means (PDFM1) comprise polyphase branches (G128,0(z) - G128,127(z)), and the interpolation means (IM1) comprises a first switch (SW11) and a second switch (SW12) each of which being coupled to outputs of the polyphase branches (G128,0(z) - G128,127(z)), wherein the interpolation means (IM1) further comprises a first amplifier (AMP11) and a second amplifier (AMP12), whereby the first amplifier (AMPL11) [***sic***] is adapted to amplify the received signal from the second switch (SW12) with a factor δ and whereby the second amplifier (AMP12) is adapted to amplify the received signal from the first switch (SW11) with a factor 1-δ, wherein the outputs of the first amplifier (AMP11) and of the second amplifier (AMP12) are coupled to an adder (AD1) for supplying a summed signal to the output (O1) of the flexible sample rate converter (FSRC1), wherein the control means (CM1) is adapted to determine the value of δ and to determine which pair of samples has to be calculated."

IX. The appellant's arguments relevant to the present decision may be summarized as follows:

The flexible sample rate converter according to claim 1 of the main request differed from the one disclosed in the closest prior art document D1 in that filter-coefficients were chosen on the basis of a required suppression of mirror spectra and a necessary relative bandwidth. It was evident that claim 1 referred to the filter coefficients of the polyphase decomposition filter means. The technical effect of this difference was a significant improvement in the quality of the converted signal.

D1 provided no hint to the skilled person to consider these criteria for signal improvement and was, in particular, silent over the idea of using a specific combination of criteria for suppressing artefacts by an appropriate filter design.

In fact, D1 explicitly taught away from the invention as claimed, since it addressed the problem of reducing the filter effort by reducing the number of filters and filter coefficients in a sampling rate converter (see D1, column 1, lines 23 to 30).

D4 disclosed only for the basic concept of sampling rate conversion that the purpose of filtering was to remove repeat spectra of the input sequence which would otherwise cause aliasing after sub-sampling. As the purpose of filtering mentioned in D4 was not linked to the concept of polyphase filtering, the skilled reader had no reason to take the teaching of D4 into account when choosing appropriate values for the various individual sub-filter coefficients of a polyphase filter.

Other passages in D4 neither disclosed not rendered obvious how to choose appropriate coefficients for the individual polyphase filters of a polyphase interpolation network. Specifically, the information that the sampling rate conversion filter implemented as a permanent structure of polyphase filters was initially designed as a low pass filter by specifying its frequency response had to be understood in such a way that the entirety of all employed polyphase filters of a polyphase interpolation network was designed as a low pass filter. There was no information about the coefficients for the individual polyphase filters of a polyphase interpolation network.

As none of the cited documents, alone or in combination, suggested to select the polyphase decomposition filters of a sample rate converter as specified in claim 1 of the main request, the subject-matter of this claim involved an inventive step within the meaning of Article 56 EPC.

Claim 1 according to the first auxiliary request included the feature that the filter coefficients were the filter coefficients of the polyphase decomposition filter means and thus clarified what was already implicit in claim 1 of the main request. For the reasons given above, claim 1 of the first auxiliary request was also inventive over the combination of D1 and D4.

Claim 1 according to the second auxiliary request differed from claim 1 of the main request in that the flexible sample rate converter further comprised an up-converter in front of the series arrangement and in that the filter coefficients were the filter coefficients of the polyphase decomposition filter means.

Document D1 failed to disclose a flexible sample rate converter comprising an auxiliary up-converter in front of the series arrangement. The technical effect of this difference was that by adding an auxiliary up-converter the up-conversion could be split into different stages. This significantly improved the converter's performance.

There was no hint in D1 that the performance of the sample rate converter could be improved by providing an auxiliary up-converter upstream of the series arrangement.

Document D2 taught away from the invention as defined in claim 1 of the second auxiliary request because in Chapter 5 emphasis was put on supposed disadvantages of multistage structures. Therefore, when trying to solve the objective technical problem of providing a sample rate converter with improved performance, the skilled person would not take into account D2.

Furthermore, D2 neither disclosed nor rendered obvious the combination of the adjustment of the filter coefficients on the basis of the criteria recited in the claim with an auxiliary up-converter arranged in front of the series arrangement of the polyphase decomposition filter means and interpolator means. However, only this combination led to the improved performance of a flexible rate converter.

Claim 1 according to the third auxiliary request was similar to claim 1 of the second auxiliary request but included a number of further significant limitations resulting in further improvement of the performance of the claimed converter. The multistage architecture of Figure 5.3c on page 195 of D2 was based on a completely different architecture as compared with claim 1 of the third auxiliary request since D2 did not relate to the concept that the input of the flexible sample rate converter was coupled to polyphase composition filter means and the output was coupled to interpolation means. Thus, the completely different concepts of D1 and D2 would never have been combined by the skilled person without inventive activity.

As to claim 1 of the <u>fourth auxiliary request</u>, the commutator model disclosed in D3 comprised only one switch such that exclusively one of the various polyphase sub-filters could be connected to an output of the 1-to-L polyphase interpolator means. However, it was explicitly stated in claim 1 of the fourth auxiliary request that the flexible sample rate converter comprised "switches". The use of the plural form of the term switch made clear that the claimed flexible sample rate converter comprised at least two switches. Document D1 had two polyphase filters arrangements each of which was equipped only with one switch for selecting a single phase. Thus, D1 did not render obvious to employ two switches which allowed for more flexible interpolation. Compared to D1, wherein a selected phase in the first filter was entirely dependent on the selected phase of the second filter, the flexible sample rate converter specified in claim 1 of the fourth auxiliary request allowed any arbitrary and independent selection between different phase numbers. Neither the filter arrangement of D1 nor the commutator model disclosed in D3 provided this important advantage. Furthermore the arrangement of the present invention required only a single filter unit and duplication of polyphase filter branches could be avoided. While the interpolator arrangement of D1 and D3 required two filter units each comprising a parallel arrangement of different polyphase sub-filters, the arrangement of the present invention had only a single filter unit.

None of the cited documents disclosed or rendered obvious to employ the combination of features recited in claim 1 of the fifth auxiliary request. Even if the two outputs of the polyphase filters 20 and 30 of D1 were interpreted as one switch, respectively, these two switches would be assigned to different polyphase filters. The same held for the commutator model for the 1-to-L polyphase interpolator disclosed in D2 and D3, because also in these documents one switch was assigned to one polyphase filter unit composed of various polyphase sub-filters. Therefore neither D1 nor D2 or D3 taught a polyphase filter unit which was equipped with two switches. As a consequence, also the combination of D1 with D2 or D1 with D3 did not lead to the subject-matter of claim 1 of the fifth auxiliary request which allowed a much more efficient sample rate conversion because only the samples which were actually needed were calculated and stored.

In summary, the subject-matter of the independent claim of all requests involved an inventive step and thus provided a basis for an allowable claim.

Reasons for the Decision

1. The appeal is admissible.

Main request

2.1 Claim 1 according to the main request relates to a flexible sample rate converter comprising the following features:

(a) a series-arrangement of polyphase decomposition filter means and interpolator means

whereby

(i) one side of the series-arrangement is coupled to an input of the flexible sample rate converter for receiving an input signal with a first sampling frequency and

(ii) the other side of the series-arrangement is coupled to an output for supplying an output signal with a second sampling frequency, and

(b) control means for controlling the polyphase decomposition filter means and the interpolation means,

wherein

(c) filter-coefficients are chosen on the basis of a required suppression of mirror spectra and a necessary relative bandwidth.

2.2 The Board accepts the appellant's interpretation of claim 1 whereby the filter-coefficients referred to in feature (c) are the filter-coefficients of the polyphase decomposition filter means.

3.1 Figure 1 of D1 shows a sampling rate converter 10 comprising two polyphase filters 20 and 30, identical in design and having N phases. As explained in D1, column 2 lines 4 to 30, the outputs from the polyphase filters are fed to the interpolator 40. The resolution of the output data signal is the product of the number of phases N of the polyphase filters 20 and 30 and of the number of steps M of the "fine command signal".

Hence, the flexible sample rate converter according to D1 comprises features (a), (i), (ii) and (b) recited in claim 1.

3.2 As pointed out by the appellant, D1 does not specify how the coefficients of the polyphase filters 20 and 30 should be selected and therefore does not explicitly disclose a sample rate converter comprising feature (c) of claim 1.

3.3 Starting from D1, a problem addressed in the present application can be seen in providing criteria for selecting the filter coefficients of the polyphase filters used in the known flexible sample rate converter.

3.4 D4 explains on page 1259 (right-hand column, second paragraph) the concept of sampling rate conversion using a conversion filter and specifies that the *"purpose of the filter is to remove repeat spectra of* *the input sequence which would otherwise <u>cause aliasing</u> after subsampling. The conversion filter can generally be described as a linear, periodically time-varying system for the purpose of analysis"* (underlining added).

Under the heading *"Initial design"*, D4 points out that, although the sampling rate conversion filter is usually implemented *"as a parallel structure of polyphase filters, it is initially designed as a conventional low-pass filter <u>by specifying its frequency response</u>. .... . The prototype conversion filter is then decomposed into polyphase filters and the coefficients are quantised such that the DC gain of all polyphase filters is unity".*

Furthermore, it is specified in D4 (last full paragraph on page 1259 - emphasis added) that the *"<u>main objective</u> of the filtering process is <u>to remove the repeat spectra</u> at multiples of the input sampling rate. <u>In doing so</u>, some of the <u>polyphase filters</u> calculate samples at new spatial positions, whereas the position of the output samples of one polyphase filter always coincides with input samples".*

As generally known in the art, it is the choice of the filter coefficients that determines the filtering characteristics and in particular a filter's ability to suppress unwanted mirror spectra without affecting the information content of the input signal.

3.5 As to the appellant's argument that D1 would explicitly teach away from the present invention, since it addressed the problem of reducing filter effort by reducing the number of filters and of filter coefficients in a sampling rate converter (see statement of grounds of appeal, page 8, first full paragraph), it is noted that the passage of D1 referred to by the appellant is supposed to highlight the advantage of using polyphase filters with interpolation (cf. D1, column 1, lines 11 to 35). The same advantage is sought also by the present invention (see application as published, page 2, lines 17 and 18).

3.6 In the light of a skilled person's general knowledge relating to the purpose of a filter in a sample rate converter and, in particular, to the design of a polyphase filter for a sample rate converter (see D4), it would be obvious to the skilled person wishing to implement a sample rate converter according to the teaching of D1 to choose the coefficients of the polyphase filter on the basis of a required suppression of mirror spectra and a necessary relative bandwidth as specified in claim 1 of the main request.

3.7 Hence, the subject-matter of claim 1 according to the main request does not involve an inventive step within the meaning of Article 56 EPC.

First auxiliary request

4.1 Claim 1 according to the first auxiliary request differs from claim 1 of the main request in that it further specifies that the filter-coefficients referred to in feature (c) are the ***"filter-coefficients of the polyphase decomposition filter means"***.

4.2 The subject-matter of claim 1 thus corresponds to the subject-matter of claim 1 of the main request according to the interpretation given by the appellant and followed in this decision (see item 2.2 of the decision). Hence, for the same reasons, the subject-matter of claim 1 does not involve an inventive step (Article 56 EPC).

Second auxiliary request

5.1 Claim 1 according to the second auxiliary request differs from claim 1 of the first auxiliary request in that it further includes the following feature:

- *"wherein the flexible sample rate converter (FSRC1) further comprises an auxiliary up-converter in front of the series-arrangement".*

5.2 Figure 5.3(c) of D2 shows a multistage interpolator comprising an auxiliary up-converter in front of a series arrangement of filters stages. On page 196 D2 points out that, in particular for high-order interpolation and decimation systems and when a required slight change in sampling rate is expressed as a ratio of large integers, a multistage implementation of a sampling rate conversion system can be and generally is more efficient than the standard single-stage structure.

5.3 The appellant has essentially argued that the multistage architecture of Figure 5.3c on page 195 of D2 was based on a different architecture, since Figure 5.3c did not relate to the concept that the input of the flexible sample rate up-converter was coupled to polyphase decomposition filter means and the output was coupled to interpolation means. The completely different concepts of D1 and D2 would never be combined by the skilled person without inventive activity.

5.4 On page 193 of D2 (section 5.0), it is pointed out that the processing involved in implementing the general conceptual model for changing the sampling rate of a signal by the rational factor L/M could be viewed as a two-stage system: first interpolating the sequence by a factor L, followed by a stage of decimation by a factor M. ***"We showed in Chapter 3 that the computational load in implementing this system (i.e., the digital filtering operations) could be efficiently performed at the lowest sampling rate of the system... .In this chapter we consider cascaded (multistage) implementations of these sampling rate conversion systems for even greater efficiencies in some cases."*** (D2, page 193, third and fourth sentences).

In other words, it is specified in D2 that the multistage sampling rate conversion considered in Chapter 5 can be implemented with sample rate converters as shown in Chapter 3, in particular with a sample rate converter comprising polyphase branches and a switch coupled to the outputs of the polyphase branches of the kind used as polyphase filters for the sample rate converter of D1, Figure 1.

5.5 Furthermore, D1 (column 1, line 30 to line 48) specifies that the purpose of using a sample rate converter comprising polyphase filters with interpolation is to reduce the memory requirement for filter coefficients while providing accurate conversion when the ratio between sampling rates is expressed as a ratio of large integers. As referred to above (see item

5.2), this is one of the cases where, according to D2, multistage implementation of sampling rate conversion is more efficient than a single structure.

5.6 Hence, in the Board's opinion, it would be obvious to a person skilled in the art to apply the concept of multistage sampling rate conversion illustrated in D2 to the sample rate converter disclosed in D1. In so doing, the skilled person would arrive at the subject-matter of claim 1 according to the second auxiliary request without involving any inventive activity (Article 56 EPC).

Third auxiliary request

6.1 Claim 1 according to the third auxiliary request differs from claim 1 according to the first auxiliary request in that it further comprises the following features:

(d) wherein the flexible rate converter (FSRC1) comprises an auxiliary up-converter with an up-conversion of at least two,

d') whereby in operation the sampling frequency or frequencies used in the flexible sample rate converter (FSRC1) are lower than or equal to the highest frequency of the input and output sampling frequencies multiplied with the auxiliary up-conversion factor.

These features are disclosed only in claim 2 of the application as originally filed and their possible technical implications are not mentioned in the description.

6.2 As pointed out above, multistage interpolators and their advantages are known in the art (cf. D2, Figure 5.3 and the paragraph bridging pages 195 and 196 and D3, section V.). As to the limitation that the up-converter should have an up-conversion factor of at least two, it is noted that an up-converter in a multistage sample rate converter is usually an interpolator with a conversion factor represented by an integer $L \geq 2$.

As shown in D3, page 321, section V., one of the consequences of using a multistage implementation for a sampling rate converter is that the interpolation rate of a sampling rate conversion stage is smaller or equal than the overall interpolation rate. Similarly, the decimation rate of a single stage is smaller or equal to the overall decimation rate. In multistage converter comprising an up-converter and a flexible sample rate converter, the conversion rate of each stage can evidently be chosen so that the conditions specified in feature (d') are fulfilled.

In view of the above, the Board considers that the subject-matter of claim 1 of the third auxiliary request does not go beyond what a person of ordinary skills would do when designing the flexible rate converter known from D1 as a multistage rate converter according to the teaching of D2 or D3.

6.3 Hence, the subject-matter of claim 1 according to the third auxiliary request does not involve an inventive step within the meaning of Article 56 EPC.

Fourth auxiliary request

7.1 Claim 1 according to the fourth auxiliary request comprises features (a) and (b) of claim 1 according to the main request (see item 2.1 of the decision) and furthermore the following:

(f) wherein the polyphase decomposition filter means (PDFM1) comprise polyphase branches (G128,0(z) - G128,127(z)), and the interpolation means (IM1) comprise switches (SW11, SW12) coupled to outputs of the polyphase branches (G128,0(z) - G128,127(z)).

7.2 As pointed out in D3, page 310, right-hand column, third paragraph from bottom, it is convenient to implement the polyphase structure in terms of a commutator model. As shown in Figure 18, a polyphase 1-to-L interpolator comprises L polyphase branches and a switch coupled to outputs of the polyphase branches. It is evident that the sample rate converter shown in Figure 1 of D1 includes feature (f) when its filters 20 and 30 are implemented in terms of the commutator model shown in Figure 18 of D3.

7.3 Hence, the subject-matter of claim 1 according to the fourth auxiliary request results from an obvious application of the known commutator model to the polyphase filters used in D1 (Article 56 EPC).

Fifth Auxiliary Request

8.1 Claim 1 according to the fifth auxiliary request comprises features (a), (b) (see item 2.1 of the decision) and the following:

(f') wherein the polyphase decomposition filter means (PDFM1) comprise polyphase branches (G128,0(z) - G128,127(z)), and the interpolation means (IM1) comprises a first switch (SW11) and a second switch (SW12) each of which being coupled to outputs of the polyphase branches (G128,0(z) - G128,127(z)),

(g) wherein the interpolation means (IM1) further comprises a first amplifier (AMP11) and a second amplifier (AMP12),

(h) whereby the first amplifier (AMP11) is adapted to amplify the received signal from the second switch (SW12) with a factor δ and

(i) whereby the second amplifier (AMP12) is adapted to amplify the received signal from the first switch (SW11) with a factor $1-\delta$,

(j) wherein the outputs of the first amplifier (AMP11) and of the second amplifier (AMP12) are coupled to an adder (AD1) for supplying a summed signal to the output (O1) of the flexible rate converter (FSRC1),

(k) wherein the control means (CM1) is adapted to determine the value of δ and to determine which pair of samples has to be calculated.

8.2 Feature (f') is essentially equivalent to feature (f) of the fourth auxiliary request.

As to features (g) to (k), Figure 1 of D1 shows a block diagram of a sample rate converter comprising two identical polyphase filters and an interpolator. An input data signal, sampled at a first sampling rate, is input to both polyphase filters. A coarse phase command from a controller selects a phase of the polyphase filter 30 and, incremented by one, a phase of the polyphase filter 20. The outputs A and B from the polyphase filters 20 and 30 are input to a linear interpolator which performs the following function:

$$C = Z*A + (1 - Z) *B$$

whereby Z has M steps between zero and one. As explained in D1, column 2, lines 24 to 30, the resulting resolution of the output data signal is the product of the number of phases N of the polyphase filters 20 and 30 and the number of steps M. Consequently, the linear interpolator provides equally spaced sub-phases between the phases of the polyphase filters 20 and 30.

The combination of features (g) to (k) recited in claim 1 of the fifth auxiliary request is essentially a description of the block diagram which represents the functions performed by the interpolator 40 according to

D1, whereby the factor δ in the claim is the same as M in D1.

8.3 The appellant has stressed that the sample rate converter according to the present invention comprised only one polyphase filter with one input and two outputs connected to respective amplifiers, whereas D1 taught to use two identical filters, each having an input and an output linked with an interpolator. The design according to the present invention was more efficient and offered the possibility of addressing any combination of branches.

8.4 In D1 only one branch of a filter is in use at any time and the indexes of the branches addressed in the first and second filters differ by 1. It is evident to the skilled person that there is no need to duplicate all the branches of a polyphase filter, since in every calculation cycle a particular branch of a polyphase filter is used only once. In fact, in the Board's opinion both Figure 1 of D1 and Figure 1 of the present application are schematic and equivalent representations of the calculations to be performed when polyphase filter coefficients and interpolation are used for converting the sample rate of an input signal.

Furthermore, there is no support in the present application for the appellant's argument that it would be advantageous to use the switches SW11 and SW12 in the sample rate converter according to the present invention to address pairs of non-consecutive branches of the polyphase filter PDFM1.

8.5 In summary, it would be obvious to a person skilled in the art, wishing to implement the block diagram of the sample rate converter shown in Figure 1, to rely on the general knowledge common in the field of polyphase filters (see D2 and D3) and thus arrive at the subject-matter of claim 1 of the fourth auxiliary request (Article 56 EPC).

9. In the result, the Board comes to the conclusion that none of the appellant's requests provides a basis for an allowable claim. Hence, the application has to be refused.

Order

For these reasons it is decided that

The appeal is dismissed.

The Registrar: The Chairman:

C. Moser M. Ruggiu