

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		
	Filing Date		
	First Named Inventor	Andrey NORKIN	
	Art Unit		
	Examiner Name		
	Attorney Docket Number	3602-518US5	

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	6167164		2006-12-26	Lee	

If you wish to add additional U.S. Patent citation information please click the Add button.

U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code ¹	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	20080117980	A1	2008-05-22	Hung Ching-Yu et al	
	2	20080123750	A1	2008-05-20	Bronstein et al	
	3	20040101059	A1	2004-05-27	Joch et al.	
	4	20060078048	A1	2006-04-13	Bjontegaard	
	5	20050147319	A1	2005-07-07	Deshpande et al.	

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number		
Filing Date		
First Named Inventor	Andrey NORKIN	
Art Unit		
Examiner Name		
Attorney Docket Number	3602-518US5	

	6	20110194614	A1	2011-08-11	Norkin et al.	
--	---	-------------	----	------------	---------------	--

If you wish to add additional U.S. Published Application citation information please click the Add button.

FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number ³	Country Code ² i	Kind Code ⁴	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	T ⁵
	1	02096117	WO	A1	2002-11-28	Pace Soft Silicon Ltd et al		☐
	2	2010080645	WO	A2	2010-07-15	Maxim Integrated Products		☐
	3	2011096869	WO	A1	2011-08-11	Ericsson Telefon AB LM et al		☐
	4	2005117447	WO	A2	2005-12-08	Qualcomm Incorporated		☐
	5	2011080645	WO	A1	2011-07-07	Telefonaktiebolaget LM Ericsson (publ)		☐
	6	101951519	CN	A	2011-01-19	Xidian University		☐

If you wish to add additional Foreign Patent Document citation information please click the Add button

NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
--------------------	---------	---	----------------

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number		
Filing Date		
First Named Inventor	Andrey NORKIN	
Art Unit		
Examiner Name		
Attorney Docket Number	3602-518US5	

1	Chun-Lung Hsu; Yu-Sheng Huang, "A Fast-Deblocking Boundary-strength Based Architecture Design of Deblocking Filter in H.264/AVC Applications", Journal of Signal Processing Systems ; for Signal, Image, and Video Technology (formerly the Journal of VLSI Signal Processing Systems for Signal, Image, and Video Technology), 2007-11-20, Springer US, Boston, ISSN 1939-8115; whole document	☐
2	Ugur, K et al, "High Performance, Low Complexity Video Coding and the Emerging HEVC Standard", In: IEEE Transactions on Circuits and Systems for Video Technology, Volume: 20 Issue:12, On pages: 1688 - 1697, ISSN: 1051-8215, Digital Object Identifier: 10.1109/TCSVT.2010.2092613, Date of Publication: 18 November 2010; whole document	☐
3	Muhammad Nadeem et al, "A high-throughput, area-efficient hardware accelerator for adaptive deblocking filter in H.264/AVC", In: IEEE/ACM/IFIP 7th Workshop on Embedded Systems for Real-Time Multimedia, ISBN 978-1-4244-5169-2, ISBN 1-4244-5169-8, pages 18-27; whole document	☐
4	NORKIN, A., et al., "Development of HEVC deblocking filter", 4th JCT-VC MEETING, 95, MPEG MEETING; 20-28 January 2011; DAEGU; (JOINT COLLABORATIVE TEAM ON VIDEO CODING OF ISO/IEC JTC1/SC29/WG11 AND ITU-T SG.16); URL:HTTP://WFTP3.ITU.INT/AV-ARCH/JCTVC-SITE/, No. JCTVC-D377, January 16, 2011, 4 pages, XP030008416	☐
5	ANONYMOUS; "Test Model under Consideration", 2nd JCT-VC MEETING; 21-28 July 2010; GENEVA; (JOINT COLLABORATIVE TEAM ON VIDEO CODING OF ISO/IEC JTC1/SC29/WG11 AND ITU-T SG. 16); URL:HTTP://WFTP3.ITU.INT/AV-ARCH/JCTVC-SITE/, No. JCTVC-B205, July 28, 2010, pp. 1-152, XP030007704	☐
6	Supplementary European Search Report issued on November 8, 2013, in corresponding European application No. EP 11 85 5586, 10 pages	☐
7	Office Action issued in corresponding Japanese Application No. JP 2013-549384, on December 20, 2013, 2 pages	☐
8	Office Action (English translation only) issued on June 25, 2015 in corresponding Taiwan application No. 101101515, 3 pages	☐
9	Office Action (English translation only) issued on August 24, 2015 in corresponding Korean Application No. 10-2013-7020997, 6 pages	☐
10	First Office Action issued in related Chinese Patent Application No. 201180064761.8, dated February 3, 2016, 6 pages	☐
11	Office Action (English translation only) issued on July 31, 2015 in corresponding Japanese application No. 2014-094843, 2 pages	☐

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number	
Filing Date	
First Named Inventor	Andrey NORKIN
Art Unit	
Examiner Name	
Attorney Docket Number	3602-518US5

If you wish to add additional non-patent literature document citation information please click the Add button

EXAMINER SIGNATURE

Examiner Signature		Date Considered	
--------------------	--	-----------------	--

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number	
Filing Date	
First Named Inventor	Andrey NORKIN
Art Unit	
Examiner Name	
Attorney Docket Number	3602-518US5

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

- ☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

- ☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

- ☐ See attached certification statement.
- ☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.
- ☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature		Date (YYYY-MM-DD)	2017-06-30
Name/Print	Brian Rosenbloom	Registration Number	41,276

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

POWER OF ATTORNEY

The undersigned, being duly authorized representatives of **TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)** (hereinafter referred to as "Ericsson") having its registered office at SE-164 83 Stockholm, Sweden, does hereby authorize **Rothwell, Figg, Ernst & Manbeck, P.C. practitioners associated with United States Patent and Trademark Office Customer Number 06449** to represent Ericsson before the United States Patent and Trademark Office in any and all matters regarding patents or patent applications filed by Ericsson or wherein Ericsson is the assignee of the entire interest thereto.

This Power of Attorney shall include the right for **Rothwell, Figg, Ernst & Manbeck, P.C. practitioners associated with United States Patent and Trademark Office Customer Number 06449** to sign and submit in Ericsson's name and on Ericsson's behalf any document, notification, filing, petition or request in connection with any patent applications or patents owned by or assigned to Ericsson.

This Power of Attorney does not include the right to appoint substitutes but only the persons associated with the above United States Patent and Trademark Office Customer Number.

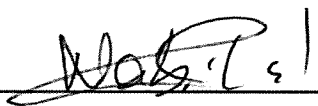
We hereby revoke all previous authorization, if any made, in respect of same matter or proceeding. This Power of Attorney shall be valid for five (5) years from the date hereof unless earlier revoked. This Power of Attorney may be revoked at any time by Ericsson.

Stockholm, Sweden on [Date] 2016-04-05

TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)

Signature(s)


Gabriele Mohsler
Vice President Patent Development


Nabil Ayoub
Director Patent Unit RAN2

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No. : Continuation of 15/008,013
First Named Inventor : Andrey NORKIN
Filed : Herewith
TC/A.U. :
Examiner :

Docket No. : 3602-518US5
Customer No. : 06449
Confirmation No. :

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

STATEMENT UNDER 37 CFR 3.73

The named Assignee, TELEFONAKTIEBOLAGET LM ERICSSON (PUBL), is the assignee of the entire right, title, and interest in the patent application identified above by virtue of an assignment from the inventor(s) of the patent application identified above for which the Assignee is attaching a copy filed in the parent application Serial No. 15/008,013 (the '013 application). The assignment in the parent '013 application was recorded on May 17, 2016, Reel/Frame 038619/0419.

Respectfully submitted,

By



Brian S. Rosenbloom
Attorney for Applicants
Registration No. 41,276
ROTHWELL, FIGG, ERNST & MANBECK, p.c.
Suite 800, 607 14th Street, N.W.
Washington, D.C. 20005
Telephone: (202)783-6040

15/008,013 DEBLOCKING FILTERING

3602-518US4

06-28-
2017::14:23:22**Patent Assignment Abstract of Title****Total Assignments: 1****Application #:** 15008013**Filing Dt:** 01/27/2016**Patent #:** NONE**Issue Dt:****PCT #:** NONE**Intl Reg #:****Publication #:** US20160142739**Pub Dt:** 05/19/2016**Inventors:** Andrey NORKIN, Kenneth ANDERSSON, Rickard SJÖBERG**Title:** DEBLOCKING FILTERING**Assignment: 1****Reel/Frame:** 038619 / 0419**Received:** 05/17/2016**Recorded:** 05/17/2016**Mailed:** 05/18/2016**Pages:** 8**Conveyance:** ASSIGNMENT OF ASSIGNORS INTEREST (SEE DOCUMENT FOR DETAILS).**Assignors:** ANDERSSON, KENNETH**Exec Dt:** 10/19/2011

NORKIN, ANDREY

Exec Dt: 10/18/2011

SJÖBERG, RICKARD

Exec Dt: 10/18/2011**Assignee:** TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)

TORSHAMNSGATAN 23, KISTA

STOCKHOLM, SWEDEN SE-164 83

Correspondent: ROTHWELL, FIGG, ERNST & MANBECK, P.C.

607 14TH STREET, N.W.

SUITE 800

WASHINGTON, DC 20005

Search Results as of: 06/28/2017 14:23:20 PM

Disclaimer:**Assignment information on the assignment database reflects assignment documents that have been actually recorded.****If the assignment for a patent was not recorded, the name of the assignee on the patent application publication or patent may be different.****If you have any comments or questions concerning the data displayed, contact OPR / Assignments at 571-272-3350****Close Window**

**DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN
APPLICATION DATA SHEET (37 CFR 1.76)**

Caution: A person may not execute an oath or declaration for an application unless that person has reviewed and understands the contents of the application, including the claims, and is aware of the duty to disclose to the US Patent and Trademark Office all information known to the person to be material to patentability as defined in 37 CFR 1.56.

Title of
Invention

DEBLOCKING FILTERING

As the below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application, or

☒ United States application or PCT international application number 13/955,448
filed on July 31, 2013.

The above-identified application was made or authorized to be made by me.

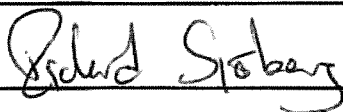
I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

LEGAL NAME OF INVENTOR

Typed Name of Inventor: Rickard SJOBERG

Signature of Inventor:



Date (optional): 2013-09-17

**DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN
APPLICATION DATA SHEET (37 CFR 1.76)**

Caution: A person may not execute an oath or declaration for an application unless that person has reviewed and understands the contents of the application, including the claims, and is aware of the duty to disclose to the US Patent and Trademark Office all information known to the person to be material to patentability as defined in 37 CFR 1.56.

Title of
Invention

DEBLOCKING FILTERING

As the below named inventor, I hereby declare that:

This declaration is directed to:



The attached application, or



United States application or PCT international application number 13/955,448
filed on July 31, 2013.

The above-identified application was made or authorized to be made by me.

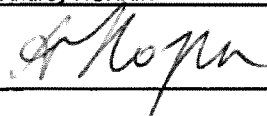
I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

LEGAL NAME OF INVENTOR

Typed Name of Inventor: Andrey NORKIN

Signature of Inventor:



Date (optional):

2013-09-12

**DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN
APPLICATION DATA SHEET (37 CFR 1.76)**

Caution: A person may not execute an oath or declaration for an application unless that person has reviewed and understands the contents of the application, including the claims, and is aware of the duty to disclose to the US Patent and Trademark Office all information known to the person to be material to patentability as defined in 37 CFR 1.56.

**Title of
Invention**

DEBLOCKING FILTERING

As the below named inventor, I hereby declare that:

This declaration is directed to:

☐ The attached application, or

☒ United States application or PCT international application number 13/955,448
filed on July 31, 2013.

The above-identified application was made or authorized to be made by me.

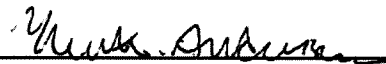
I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

LEGAL NAME OF INVENTOR

Typed Name of Inventor: Kenneth ANDERSSON

Signature of Inventor:



Date (optional): 2013-09-17

DEBLOCKING FILTERING

CROSS-REFERENCE TO RELATED APPLICATIONS

[001] This application is a continuation of U.S. application no. 15/008,013, filed on January 27, 2016 (published as US 20160142739), which is a continuation of U.S. application no. 13/955,448, filed on July 31, 2013 (now U.S. Patent 9,407,912), which is a continuation of U.S. application no. 13/583,437, having a § 371 date of Sep. 7, 2012 (now U.S. Patent 8,526,509), which is a 35 U.S.C. § 371 National Phase Entry Application from PCT/SE2011/051199, filed October 6, 2011, which claims the benefit of U.S. Provisional App. No. 61/432,751, filed January 14, 2011. The above identified applications and publications are incorporated by reference herein in their entirety.

TECHNICAL FIELD

[002] The present description relates to deblocking filtering for reducing blocking artifacts at block boundaries.

BACKGROUND

[003] Deblocking filters are used in the video coding standards in order to combat blocking artifacts. The blocking artifacts arise because the original video is split into blocks which are processed relatively independently. The blocking artifacts can, for instance, arise due to different intra predictions of the blocks, quantization effects and motion compensation. Two particular variants of deblocking are described below.

[004] H.264 deblocking

[005] In state of the art video coding, such as H.264, there is a deblocking filter, also denoted loop filter, after prediction and residual reconstruction, but before storage of the reconstruction for later reference when encoding or decoding the subsequent frames. The deblocking filtering consists of several steps such as filter decisions, filtering operations, a clipping function and changes of pixel values. The decision to filter the border or not is made based on evaluation of several conditions. Filter decisions depend on macroblock (MB) type,

motion vector (MV) difference between neighboring blocks, whether neighboring blocks have coded residuals and on the local structure of the current and/or neighboring blocks.

[006] Then the amount of filtering for a pixel depends, among others, on the position of that pixel relative to the block border or boundary and on the quantization parameter (QP) value used for residual coding.

[007] The filter decision is based on comparing three pixel differences with three thresholds. The thresholds are adapted to the quantization parameter (QP). For instance, assume a vertical block boundary of a b c d | e f g h where a, b c and d denote the pixel values of the pixels of a row of pixels in the current block with e, f, g and h denoting the corresponding pixel values of the pixels of a corresponding row of pixels in the neighboring block. If the following conditions are fulfilled the filter decision is positive, e.g. $\text{abs}(d-e) < \text{thr1}$, $\text{abs}(c-d) < \text{thr2}$, and $\text{abs}(e-f) < \text{thr2}$, where thr1 and thr2 are adapted based on QP.

[008] There are two filtering modes in H.264. In the first filtering mode, referred to as normal filtering, filtering can be described with a delta value with which filtering changes the current value with. The filtering for the pixels closest to the block boundary is $d' = d + \text{delta}$ and $e' = e - \text{delta}$, where delta has been clipped off to a threshold $\pm \text{thr3}$ to a value that is constrained by the QP. More filtering is thereby allowed for high QP than for low QP. Clipping can be described as $\text{delta_clipped} = \max(-\text{thr3}, \min(\text{thr3}, \text{delta}))$, where thr3 is controlling the filter strength. A larger value of thr3 means that the filtering is stronger which means that a stronger low-pass filtering effect will happen.

[009] The filter strength can be increased if any of the following two conditions also holds, e.g. $\text{abs}(b-d) < \text{thr2}$ and $\text{abs}(e-g) < \text{thr2}$. The filter strength is adapted by clipping the delta less, e.g. allow for more variation.

[0010] The second filtering mode, referred to as strong filtering, is applied for intra macroblock boundaries only, when the following condition is fulfilled $\text{abs}(d-e) < \text{thr1}/4$.

[0011] For more information of deblocking filtering in H.264 reference is made to List et al., Adaptive Deblocking Filter, *IEEE Transactions on Circuits and Systems for Video Technology*, vol. 13, no. 7, July 2003.

[0012] Deblocking in HEVC draft

[0013] In the draft HEVC (High Efficiency Video Coding) specification “Test Model under Consideration”, ITU-T SG16 WP3 document, JCTVC-B205, Chapter 6.5 In-loop filter process, the deblocking filter works differently from H.264. The filtering is performed if at least one of the blocks on the side of the boundary is intra, or has non-zero coefficients, or the difference between the motion vector components of the blocks is greater or equal to one integer pixel. For example, when filtering the border between the blocks with a vertical block boundary of

$$p3_i p2_i p1_i p0_i | q0_i q1_i q2_i q3_i$$

with pj_i denoting the pixel value of pixel number j of row number i in the current block and qj_i denoting the pixel value of pixel number j of row number i in the neighboring block, $i=0\dots7$, $j=0\dots3$, then the following condition should also be satisfied:

$$d = |p2_2 - 2 \times p1_2 + p0_2| + |q2_2 - 2 \times q1_2 + q0_2| + \\ |p2_5 - 2 \times p1_5 + p0_5| + |q2_5 - 2 \times q1_5 + q0_5| < \beta$$

where β depends on QP. In the above mentioned HEVC specification, there is a table of β , where β increases with QP.

[0014] If the conditions are fulfilled and filtering is done between the current block and the neighboring block, one of two types of filtering is performed, referred to as weak and strong filtering, respectively. The choice between the strong and the weak filtering is done separately for each line depending on the following conditions. For each line $i=0\dots7$, the strong filtering is performed if all the following conditions are true, otherwise, weak filtering is performed:

$$d < (\beta \gg 2)$$

$$(|p_{3i} - p_{0i}| + |q_{0i} - q_{3i}|) < (\beta \gg 3)$$

$$|p_{0i} - q_{0i}| < ((5 \times t_C + 1) \gg 1)$$

where t_C and β depend on QP and $\gg$ denotes a right shift operator.

[0015] Weak filtering in HEVC draft

[0016] Weak filtering is performed based on the above conditions. The actual filtering works by computing an offset (Δ), adding it to the original pixel value and clip the sum to a filtered output pixel value in the range of 0-255:

$$\Delta = \text{Clip}(-t_C, t_C, (13 \times (q_{0i} - p_{0i}) + 4 \times (q_{1i} - p_{1i}) - 5 \times (q_{2i} - p_{2i}) + 16) \gg 5))$$

$$p_{0i} = \text{Clip}_{0-255}(p_{0i} + \Delta)$$

$$q_{0i} = \text{Clip}_{0-255}(q_{0i} - \Delta)$$

$$p_{1i} = \text{Clip}_{0-255}(p_{1i} + \Delta/2)$$

$$q_{1i} = \text{Clip}_{0-255}(q_{1i} - \Delta/2)$$

where the clip function $\text{Clip}(A, B, x)$ is defined as $\text{Clip}(A, B, x) = A$ if $x < A$, $\text{Clip}(A, B, x) = B$ if $x > B$ and $\text{Clip}(A, B, x) = x$ if $A \leq x \leq B$ and $\text{Clip}_{0-255}(x)$ is defined as $\text{Clip}(0, 255, x)$.

[0017] Strong filtering in HEVC draft

[0018] Strong filtering mode is performed by the following set of operations:

$$p_{0i} = \text{Clip}_{0-255}((p_{2i} + 2 \times p_{1i} + 2 \times p_{0i} + 2 \times q_{0i} + q_{1i} + 4) \gg 3)$$

$$q_{0i} = \text{Clip}_{0-255}((p_{1i} + 2 \times p_{0i} + 2 \times q_{0i} + 2 \times q_{1i} + q_{2i} + 4) \gg 3)$$

$$p_{1i} = \text{Clip}_{0-255}((p_{2i} + p_{1i} + p_{0i} + q_{0i} + 2) \gg 2)$$

$$q1_i = \text{Clip}_{0-255}((p0_i + q0_i + q1_i + q2_i + 2) \gg 2)$$

$$p2_i = \text{Clip}_{0-255}((2 \times p3_i + 3 \times p2_i + p1_i + p0_i + q0_i + 4) \gg 3)$$

$$q2_i = \text{Clip}_{0-255}((p0_i + q0_i + q1_i + 3 \times q2_i + 2 \times q3_i + 4) \gg 3)$$

[0019] One problem with the deblocking in HEVC is that the weak filter does not have good low-pass characteristics. One can see that the first and the second pixels from the block border are modified by adding or subtracting Δ and $\Delta/2$ respectively. Such a filter cannot remove high frequencies that can appear near the block border and cannot remove ringing. Moreover, the frequency characteristics of the filter in HEVC show slight amplifications of higher frequencies when filtering the second pixel ($p1_i$ and $q1_i$) from the block boundary, which can result in worse rate-distortion (RD) performance of the coder. Moreover, the offset for pixel $p1_i$ is equal in magnitude to the offset of pixel $q1_i$ although the structure of the signal can be different on different sides of the block boundary. Therefore, the HEVC filter does not adapt well to the local structure of the side of the block boundary.

[0020] Hence, there is a need for an efficient deblocking filter that can be used to reduce blocking artifacts at block boundaries and that does not have the above mentioned drawbacks.

SUMMARY

[0021] It is a general objective to combat blocking artifacts at block boundaries between blocks of pixels in a video frame.

[0022] This and other objectives are met by embodiments as disclosed herein.

[0023] An aspect of the embodiments defines a method of reducing blocking artifacts at a block boundary between a block of pixels and a neighboring block of pixels in a video frame. The method calculates a first offset to be based on $(9 \times (q0 - p0) - 3 \times (q1 - p1)) / 16$, wherein $p0$ denotes a pixel value of a pixel closest to the block boundary in a line of pixels in the block, $p1$ denotes a pixel value of a pixel next closest to the block boundary in the line of pixels, $q0$ denotes a pixel value of a pixel closest to the block boundary in a corresponding line of pixels in

the neighboring block and q_1 denotes a pixel value of a pixel next closest to the block boundary in the corresponding line of pixels. The line of pixels and the corresponding line of pixels are perpendicular to the block boundary. The pixel value of the pixel closest to the block boundary in the line of pixels is modified by adding the first offset to the pixel value of this pixel to form a modified pixel value. Correspondingly, the pixel value of the pixel closest to the block boundary but in the corresponding line of pixels is modified by subtracting the first offset from the pixel value of this pixel to form a modified pixel value.

[0024] In an optional embodiment of this aspect, the first offset is calculated to be equal to $(9 \times (q_0 - p_0) - 3 \times (q_1 - p_1) + 8) \gg 4$, wherein $\gg$ denotes a right shift operation.

[0025] In an optional embodiment of this aspect, the method further comprises clipping the first offset to be within an interval of $-t_C$ and t_C by setting the first offset to be equal to $-t_C$ if the first offset is smaller than $-t_C$ and by setting the first offset to be equal to t_C if the first offset is larger than t_C , wherein t_C is a threshold value that is dependent on a quantization parameter value assigned to the block.

[0026] In an optional embodiment of this aspect, the method further comprises clipping the modified pixel value of the pixel closest to said block boundary in the line of pixels to be within an interval of zero and a defined maximum value and clipping the modified pixel value of the pixel closest to the block boundary in the corresponding line of pixels to be within an interval of zero and the defined maximum value. This optional clipping is achieved by setting the modified pixel value to be equal to zero if the modified pixel value is smaller than zero and by setting the modified pixel value to be equal to the defined maximum value if the modified pixel value is larger than the defined maximum value.

[0027] In an optional embodiment of this aspect, the method further comprises calculating a second offset to be based on $(p_2 + p_0 - 2 \times p_1 + 2 \times \Delta) / 4$, wherein p_2 denotes a pixel value of a pixel second next closest to the block boundary in the line of pixels and Δ denotes the first offset. The method also comprises, in this optional embodiment, calculating a

third offset to be based on $(q_2 + q_0 - 2 \times q_1 - 2 \times \Delta) / 4$, wherein q_2 denotes a pixel value of a pixel second next closest to the block boundary in the corresponding line of pixels. The pixel value of the pixel next closest to the block boundary in the line of pixels is then modified by adding the second offset to the pixel value of the pixel next closest to the block boundary in the line of pixels to form a modified pixel value. Correspondingly, the method also comprises, in this optional embodiment, modifying the pixel value of the pixel next closest to the block boundary in the corresponding line of pixels by adding the third offset to the pixel value of the pixel next closest to the block boundary in the corresponding line of pixels to form a modified pixel value.

[0028] In an optional embodiment of this aspect, the second offset is calculated to be equal to $((p_2 + p_0 + 1) \gg 1) - p_1 + \Delta$, wherein $\gg$ denotes a right shift operation and the third offset is calculated to be equal to $((q_2 + q_0 + 1) \gg 1) - q_1 - \Delta$.

[0029] In an optional embodiment of this aspect, the method further comprises clipping the second offset within an interval of $-t_{C2}$ and t_{C2} and clipping the third offset within an interval of $-t_{C2}$ and t_{C2} , wherein t_{C2} is a threshold value that is dependent on a quantization parameter value assigned to the block. This optional clipping is achieved by setting the second or third offset to be equal to $-t_{C2}$ if the second or third offset is smaller than $-t_{C2}$ and by setting the second or third offset to be equal to t_{C2} if the second or third offset is larger than t_{C2} .

[0030] In an optional embodiment of this aspect, the method further comprises clipping the modified pixel value of the pixel next closest to the block boundary in the line of pixels within an interval of zero and a defined maximum value and clipping the modified pixel value of the next pixel closest to the block boundary in the corresponding line of pixels within an interval of zero and the defined maximum value. This optional clipping is achieved by setting the modified pixel value to be equal to zero if the modified pixel value is smaller than zero and by setting the modified pixel value to be equal to the defined maximum value if the modified pixel value is larger than the defined maximum value.

[0031] In an optional embodiment of this aspect, the method further comprises calculating a fourth offset to be based on $(p_3 + p_1 - 2 \times p_2 + 2 \times \Delta_{p1}) / 4$, wherein p_3 denotes a pixel value of a pixel third next closest to the block boundary in the line of pixels and Δ_{p1} denotes the second offset. The method also comprises, in this optional embodiment, calculating a fifth offset to be based on $(q_3 + q_1 - 2 \times q_2 + 2 \times \Delta_{q1}) / 4$, wherein q_3 denotes a pixel value of a pixel third closest to the block boundary in the corresponding line of pixels and Δ_{q1} denotes the third offset. The pixel value of the pixel second next closest to the block boundary in the line of pixels is modified by adding the fourth offset to the pixel value of the pixel second next closest to the block boundary in the line of pixels to form a modified pixel value. The method also comprises, in this optional embodiment, modifying the pixel value of the pixel second next closest to the block boundary in the corresponding line of pixels by adding the fifth offset to the pixel value of the pixel second next closest to the block boundary in the corresponding line of pixels to form a modified pixel value.

[0032] In an optional embodiment of this aspect, the fourth offset is calculated to be equal to $((p_3 + p_1 + 1) \gg 1) - p_2 + \Delta_{p1}$, wherein $\gg$ denotes a right shift operation and the fifth offset is calculated to be equal to $((q_3 + q_1 + 1) \gg 1) - q_2 + \Delta_{q1}$.

[0033] In an optional embodiment of this aspect a deblocking filter unit calculates the first offset to be based on $(9 \times (q_0 - p_0) - 3 \times (q_1 - p_1)) / 16$. The deblocking filter unit modifies the pixel value of the pixel closest to the block boundary in the line of pixels by adding the first offset to the pixel value of the pixel closest to the block boundary in the line of pixels to form a modified pixel value. The deblocking filter unit also modifies the pixel value of the pixel closest to the block boundary in the corresponding line of pixels by subtracting the first offset from the pixel value of the pixel closest to the block boundary in the corresponding line of pixels to form a modified pixel value.

[0034] Another aspect of the embodiments defines a deblocking filter unit for reducing blocking artifacts at a block boundary between a block of pixels and a neighboring block of pixels in a video frame. The deblocking filter unit comprises a first offset calculator configured to calculate a first offset to be based on $(9 \times (q_0 - p_0) - 3 \times (q_1 - p_1)) / 16$, wherein p_0 denotes a pixel value of a pixel closest to the block boundary in a line of pixels in the block, p_1 denotes a pixel value of a pixel next closest to the block boundary in the line of pixels, q_0 denotes a pixel value of a pixel closest to the block boundary in a corresponding line of pixels in the neighboring block and q_1 denotes a pixel value of a pixel next closest to the block boundary in the corresponding line of pixels. The line of pixels and the corresponding line of pixels are perpendicular to the block boundary. The deblocking filter unit also comprises a pixel value modifier configured to modify the pixel value of the pixel closest to the block boundary in the line of pixels by adding the first offset to the pixel value of this pixel to form a modified pixel value. The pixel value modifier is also configured to modify the pixel value of the pixel closest to the block boundary but in the corresponding line of pixels by subtracting the first offset from the pixel value of this pixel to form a modified pixel value.

[0035] In an optional embodiment of this aspect, the first offset calculator is configured to calculate the first offset to be equal to $(9 \times (q_0 - p_0) - 3 \times (q_1 - p_1) + 8) \gg 4$, wherein $\gg$ denotes a right shift operation.

[0036] In an optional embodiment of this aspect, the deblocking filter unit comprises a first clipping unit configured to clip the first offset to be within an interval of $-t_C$ and t_C by setting the first offset to be equal to $-t_C$ if the first offset is smaller than $-t_C$ and by setting the first offset to be equal to t_C if the first offset is larger than t_C , wherein t_C is a threshold value that is dependent on a quantization parameter value assigned to the block.

[0037] In an optional embodiment of this aspect, the deblocking filter unit comprises a second clipping unit configured to clip the modified pixel value of the pixel closest to the block boundary in the line of pixels within an interval of zero and a defined maximum value, and clip

the modified pixel value of the pixel closest to the block boundary in the corresponding line of pixels within an interval of zero and the defined maximum value. This optional clipping by the optional second clipping unit is achieved by setting the modified pixel value to be equal to zero if the modified pixel value is smaller than zero and by setting the modified pixel value to be equal to the defined maximum value if the modified pixel value is larger than the defined maximum value.

[0038] In an optional embodiment of this aspect, the deblocking filter unit comprises a second offset calculator configured to calculate a second offset to be based on $(p_2 + p_0 - 2 \times p_1 + 2 \times \Delta) / 4$, wherein p_2 denotes a pixel value of a pixel second next closest to the block boundary in the line of pixels and Δ denotes the first offset. The deblocking filter unit also comprises, in this optional embodiment, a third offset calculator configured to calculate a third offset to be based on $(q_2 + q_0 - 2 \times q_1 - 2 \times \Delta) / 4$, wherein q_2 denotes a pixel value of a pixel second next closest to the block boundary in the corresponding line of pixels. In this optional embodiment the pixel value modifier is configured to modify the pixel value of the pixel next closest to the block boundary in the line of pixels by adding the second offset to the pixel value of the pixel next closest to the block boundary in the line of pixels to form a modified pixel value, and to modify the pixel value of the pixel next closest to the block boundary in the corresponding line of pixels by adding the third offset to the pixel value of the pixel next closest to the block boundary in the corresponding line of pixels to form a modified pixel value.

[0039] In an optional embodiment of this aspect, the second offset calculator is configured to calculate the second offset to be equal to $((p_2 + p_0 + 1) \gg 1) - p_1 + \Delta \gg 1$, wherein $\gg$ denotes a right shift operation, and the third offset calculator is configured to calculate the third offset to be equal to $((q_2 + q_0 + 1) \gg 1) - q_1 - \Delta \gg 1$.

[0040] In an optional embodiment of this aspect, the deblocking filter unit comprises a third clipping unit configured to clip the second offset within an interval of $-t_{C2}$ and t_{C2} , and clip the third offset within an interval of $-t_{C2}$ and t_{C2} , wherein t_{C2} is a threshold value that is dependent on a quantization parameter value assigned to the block. This optional clipping by the

optional third clipping unit is achieved by setting the second or third offset to be equal to $-t_{C2}$ if the second or third offset is smaller than $-t_{C2}$ and by setting the second or third offset to be equal to t_{C2} if the second or third offset is larger than t_{C2} .

[0041] In an optional embodiment of this aspect, the deblocking filter unit comprises a second clipping unit configured to clip the modified pixel value of the pixel next closest to the block boundary in the line of pixels within an interval of zero and a defined maximum value, and clip the modified pixel value of the next pixel closest to the block boundary in the corresponding line of pixels within an interval of zero and the defined maximum value. This optional clipping by the optional second clipping unit is achieved by setting the modified pixel value to be equal to zero if the modified pixel value is smaller than zero and by setting the modified pixel value to be equal to the defined maximum value if the modified pixel value is larger than the defined maximum value.

[0042] In an optional embodiment of this aspect, the deblocking filter unit comprises a fourth offset calculator configured to calculate a fourth offset to be based on $(p_3 + p_1 - 2 \times p_2 + 2 \times \Delta_{p1})/4$, wherein p_3 denotes a pixel value of a pixel third next closest to the block boundary in the line of pixels and Δ_{p1} denotes the second offset. The deblocking filter unit also comprises, in this optional embodiment, a fifth offset calculator configured to calculate a fifth offset to be based on $(q_3 + q_1 - 2 \times q_2 + 2 \times \Delta_{q1})/4$, wherein q_3 denotes a pixel value of a pixel third closest to the block boundary in the corresponding line of pixels and Δ_{q1} denotes the third offset. In this optional embodiment the pixel value modifier is configured to modify the pixel value of the pixel second next closest to the block boundary in the line of pixels by adding the fourth offset to the pixel value of the pixel second next closest to the block boundary in the line of pixels to form a modified pixel value, and modify the pixel value of the pixel second next closest to the block boundary in the corresponding line of pixels by adding the fifth offset to the pixel value of the pixel second next closest to the block boundary in the corresponding line of pixels to form a modified pixel value.

[0043] In an optional embodiment of this aspect, the fourth offset calculator is configured to calculate the fourth offset to be equal to $\left(\left((p_3 + p_1 + 1) \gg 1\right) - p_2 + \Delta_{p_1}\right) \gg 1$, wherein $\gg$ denotes a right shift operation, and the fifth offset calculator is configured to calculate the fifth offset to be equal to $\left(\left((q_3 + q_1 + 1) \gg 1\right) - q_2 + \Delta_{q_1}\right) \gg 1$.

[0044] Further aspects of the embodiments define an encoder and a decoder, respectively, comprising a deblocking filter unit as defined above.

[0045] Furthermore, an aspect of the embodiments defines a user equipment comprising a memory configured to stored encoded video frames, a decoder as defined above configured to decode the encoded video frames into decoded video frames and a media player configured to render the decoded video frames into video data that is displayable on a display.

[0046] Another aspect defines a network device being or belonging to a network node in a communication network between a sending unit and a receiving user equipment. The network device comprises an encoder and/or a decoder as defined above.

[0047] A further aspect of the embodiments defines a computer program for reducing blocking artifacts at a block boundary between a block of pixels and a neighboring block of pixels in a video frame. The computer program comprises code means which when run on a computer causes the computer to calculate an offset to be based on $(9 \times (q_0 - p_0) - 3 \times (q_1 - p_1)) / 16$, wherein p_0 denotes a pixel value of a pixel closest to the block boundary in a line of pixels in the block, p_1 denotes a pixel value of a pixel next closest to the block boundary in the line of pixels, q_0 denotes a pixel value of a pixel closest to the block boundary in a corresponding line of pixels in the neighboring block and q_1 denotes a pixel value of a pixel next closest to the block boundary in the corresponding line of pixels. The line of pixels and the corresponding line of pixels are perpendicular to the block boundary. The computer is also caused to modify the pixel value of the pixel closest to the block boundary in the line of pixels by adding the offset to the pixel value of this pixel. The code means further

causes the computer to modify the pixel value of the pixel closest to the block boundary in the corresponding line of pixels by subtracting the offset from the pixel value of this pixel.

[0048] Yet another aspect of the embodiments defines a computer program product comprising computer readable code means and a computer program as defined above stored on the computer readable means.

[0049] The present embodiments enable efficient reduction in blocking artifacts and also have good low-pass characteristics.

BRIEF DESCRIPTION OF THE DRAWINGS

[0050] The invention, together with further objects and advantages thereof, may best be understood by making reference to the following description taken together with the accompanying drawings, in which:

[0051] Fig. 1 is a flow diagram illustrating a method of reducing blocking artifacts according to an embodiment;

[0052] Figs. 2A and 2B illustrate two embodiments of neighboring blocks and a block boundary over which de-blocking filtering can be applied;

[0053] Fig. 3 is a flow diagram illustrating additional, optional steps of the method in Fig. 1 according to an embodiment;

[0054] Fig. 4 is a flow diagram illustrating additional, optional steps of the method in Figs. 1 and 5 according to an embodiment;

[0055] Fig. 5 is a flow diagram illustrating additional, optional steps of the method in Fig. 1 according to another embodiment;

[0056] Fig. 6 is a flow diagram illustrating additional, optional steps of the method in Fig. 5 according to an embodiment;

[0057] Fig. 7 is a flow diagram illustrating additional, optional steps of the method in Fig. 5 according to another embodiment;

[0058] Fig. 8 is a schematic block diagram of a deblocking filter unit according to an embodiment;

[0059] Fig. 9 is a schematic block diagram of a deblocking filter unit according to another embodiment;

[0060] Fig. 10 is a schematic block diagram of a software implementation of a deblocking filter module in a computer according to an embodiment;

[0061] Fig. 11 is a schematic block diagram of an encoder according to an embodiment;

[0062] Fig. 12 is a schematic block diagram of a decoder according to an embodiment;

[0063] Fig. 13 is a schematic block diagram of a user equipment according to an embodiment; and

[0064] Fig. 14 is a schematic overview of a portion of a communication network comprising a network device according to an embodiment.

DETAILED DESCRIPTION

[0065] Throughout the drawings, the same reference numbers are used for similar or corresponding elements.

[0066] The embodiments generally relate to deblocking filtering to combat blocking artifacts over block boundaries in a video frame. The embodiments use a deblocking filter that

has good frequency characteristics. The present deblocking filter is configured not to modify the pixel values over a block boundary if these pixel values form a ramp but smooth the pixel values if they instead are in the form of a step. This implies that the deblocking filter will have good lowpass characteristics and can remove high frequencies that can appear near the block boundary.

[0067] Fig. 1 is a flow diagram of a method of reducing blocking artifacts at a block boundary between a block of multiple pixels and a neighboring block of multiple pixels in a video frame according to an embodiment. As is well-known in the art, a video frame is divided into non-overlapping blocks of pixels that are encoded and decoded according to the various available intra and inter coding modes. Generally, a video frame is divided into non-overlapping macroblocks of 16×16 pixels. Such a macroblock can in turn be divided into smaller blocks of different sizes, such as 4×4 or 8×8 pixels. However, also rectangular blocks could be possible according to the embodiments, such as, 4×8, 8×4, 8×16 or 16×8. The embodiments can be applied to any such block of pixels, including macroblocks or even larger blocks of pixels.

[0068] In the emerging High Efficiency Video Coding (HEVC) standard, coding units (CU), prediction units (PU) and transform units (TU) are used. The prediction units are defined inside a coding unit and contain the intra or inter prediction modes. Transform units are defined inside a coding unit and the largest transform size is 32×32 pixels and the smallest size is 4×4 pixels. The CU size is currently varying from 64×64 pixels (largest) to 4×4 pixels (smallest). In this way, the largest CU can be split into smaller CUs with the “level of granularity” depending on the local characteristics of the frame. That means that the largest CU may be split into smaller CUs of different sizes. The embodiments can also be used in connection with such coding units, which are regarded as being encompassed by the expression “block of pixels” as used herein.

[0069] Each pixel in the block has a respective pixel value. Video frames generally have color values assigned to the pixels, where the color values are represented in a defined color formats. One of the common color formats uses one luminance component and two chrominance components for each pixel, although other formats exist, such as using red, green and blue components for each pixel.

[0070] Traditionally, luminance component filtering and chrominance component filtering are done separately possibly employing different filtering decisions and different deblocking filters. It is, though, possible that the luminance filtering decisions are used in chroma filtering, like in HEVC. The embodiments can be applied to filter the luminance component, filter the chrominance component or filter both the luminance component and the chrominance component. In a particular embodiment, the embodiments are applied to achieve luminance or luma filtering. Filtering decisions, or parts of filtering decisions for one component, such as luma, can be then used when making the filtering decisions for other components, such as chroma.

[0071] Deblocking filtering is conducted over a boundary, edge or border between neighboring blocks. As a consequence, such boundaries can be vertical boundaries 1, see Fig. 2A, between two neighboring blocks 10, 20 present side by side in the video frame. Alternatively, the boundaries are horizontal boundaries 1, see Fig. 2B, between two neighboring block 10, 20, where one block 10 is positioned above the other block 20 in the video frame. In a particular embodiment, vertical boundaries are filtered first starting from the left-most boundary and proceeding through the boundaries towards the right-hand side in their geometrical order. Then, horizontal boundaries are filtered starting with the boundary on the top and proceeding through the boundaries towards the bottom in their geometrical order. The embodiments are, however, not limited to this particular filtering order and can actually be applied to any predefined filtering order. In a particular embodiment, the boundaries at the edge of the video frame are preferably not filtered and thereby excluded from the deblocking filtering.

[0072] The method of this embodiment starts in step S1 where a first offset or delta is calculated for a line 12 of pixels 11, 13, 15, 17 in the block 10. According to the embodiments, this first offset is calculated based on $(9 \times (q_0 - p_0) - 3 \times (q_1 - p_1)) / 16$, wherein p_0 denotes the pixel value of the pixel 11 closest to the block boundary 1 in the line 12 of pixels 11, 13, 15, 17 in the block 10, p_1 denotes the pixel value of the pixel 13 next closest to the block boundary 1 in the line 12 of pixels 11, 13, 15, 17, q_0 denotes the pixel value of the pixel 21 closest to the block

boundary 1 in a corresponding or opposing line 22 of pixels 21, 23, 25, 27 in a neighboring block 20 and q_1 denotes the pixel value of the pixel 23 next closest to the block boundary 1 in the corresponding line 22 of pixels 21, 23, 25, 27.

[0073] The line 12 of pixels 11, 13, 15, 17 in the block 10 and the corresponding line 22 of pixels 21, 23, 25, 27 in the neighboring block 20 belong to the same horizontal line of pixels, i.e. row of pixels, extending over a vertical boundary 1, see Fig. 2A, or belong to the same vertical line of pixels, i.e. column of pixels, extending over a horizontal boundary 1, see Fig. 2B. Hence, the line 12 of pixels 11, 13, 15, 17 and the corresponding line 22 of pixels 21, 23, 25, 27 are perpendicular to the block boundary 1 between the block 10 and the neighboring block 20. Furthermore, the line 12 of pixels 11, 13, 15, 17 in the block 10 and the corresponding line 22 of pixels 21, 23, 25, 27 in the neighboring block 20 have the same line number. For instance, if the block 10 and the neighboring block 20 each comprises N , such as eight, rows or columns of pixels, having row or column numbers $i=0\dots N-1$ then the line 10 of pixels 11, 13, 15, 17 has line number i in the block 10 and the corresponding line 20 of pixels 21, 23, 25, 27 also has line number i but in the neighboring block 20. Thus, line 12 of pixels 11, 13, 15, 17 in the block and the corresponding line 22 of pixels 21, 23, 25, 27 in the neighboring block 20 are opposing lines with regard to the block boundary 1.

[0074] According to the embodiments, “line of pixels” and “corresponding line of pixels” are employed to denote a “row of pixels” and a “corresponding row of pixels” in the case of a vertical block boundary as in Fig. 2A and denote a “column of pixels” and a “corresponding column of pixels” in the case of a horizontal block boundary as in Fig. 2B.

[0075] A next step S2 modifies the pixel value of the pixel 11 closest to the block boundary 1 in the line 12 of pixels 11, 13, 15, 17 by adding the first offset calculated in step S1 to the pixel value of this pixel 11 to form a modified pixel value p_0' . Thus, the modified pixel value p_0' for this pixel 11 is $p_0' = p_0 + \Delta$, wherein Δ denotes the first offset from step S1. Correspondingly, the pixel value of the pixel 21 closest to the block boundary 1 but in the corresponding line 22 of pixels 21, 23, 25, 27 in the neighboring block 20 is modified in step S3

by subtracting the first offset from the pixel value of this pixel 21 to form a modified pixel value $q0'$. The modified pixel value $q0'$ is therefore calculated as $q0' = q0 - \Delta$.

[0076] The modification of the pixel value for the pixel 11 closest to the block boundary 1 in the line 12 of pixels 11, 13, 15, 17 in the block 10 in step S2 and the modification of the pixel value for the pixel 21 closest to the block boundary 1 in the corresponding line 22 of pixels 21, 23, 25, 27 in the neighboring block 20 in step S3 can be performed serially as illustrated in Fig. 1 or serially but in the opposite order, i.e. step S3 prior to step S2. Alternatively, the two steps S2 and S3 can be performed at least partly in parallel.

[0077] The method illustrated in Fig. 1 and including steps S1 to S3 reduces blocking artifacts at the block boundary 1 by processing pixels in one line 11 of pixels 11, 13, 15, 17 in the block and also in the corresponding line 22 of pixels 21, 23, 25, 27 in the neighboring block 20. This pixel modification can be performed for one of the (horizontal or vertical) lines 12 in the block 10 or for multiple, i.e. at least two, lines 12 in the block 10, possibly for all (horizontal or vertical) lines 12 in the block 10. This is schematically illustrated by the line L1.

[0078] Generally, and which was discussed in the foregoing, deblocking filtering involves filter decisions that determine whether a deblocking filter is to be applied over a horizontal or vertical block boundary for a block. If such a decision is positive the deblocking filter is then possibly applied to all columns (vertical lines) or rows (horizontal lines) of the block. Alternatively, further filtering decisions are taken for each column or row to decide whether deblocking filter is to be applied or not and/or what type of deblocking filter to use for that particular column or row. Therefore, the method as illustrated in Fig. 1 could be applied to a column, to a row, to multiple columns, to multiple rows or both for at least one column and at least one row in a block of pixels in the video frame. It is further anticipated that deblocking filtering does not necessarily have to be applied to all blocks in the video frame. In clear contrast, such deblocking filtering is preferably only applied to the blocks and over block boundaries where there are blocking artifacts as determined by one or more filter decisions.

[0079] The deblocking filtering will now be further described herein in connection with various implementation embodiments.

[0080] Clipping of the first offset can be performed in an embodiment to thereby restrict the value of the first offset to be within an interval of $-t_C$ and t_C . The threshold value t_C is preferably dependent on a quantization parameter (QP) value assigned to the block. In such a case, a table of different threshold values for different QP values could be used. Table 1 listed below is an example of such a table.

Table 1 - t_C values for different QP values

QP	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
t_C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
QP	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
t_C	1	1	1	1	1	1	1	1	2	2	2	2	3	3	3	3	4	4	4
QP	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	
t_C	5	5	6	6	7	8	9	9	10	10	11	11	12	12	13	13	14	14	

[0081] The present embodiments are, however, not limited to the particular relationship between t_C and QP as shown in Table 1 but could instead determine the t_C value for the block based on the QP value for the block in some other way.

[0082] Fig. 3 illustrates this clipping action. The method then continues from step S1 of Fig. 1. A next step S10 investigates whether the first offset is within the interval $-t_C$ and t_C , i.e. whether $-t_C \leq \Delta \leq t_C$. In such a case, the method continues to step S2 of Fig. 1 and no modification of the first offset is required. However, if the first offset is not within the interval as determined in step S10 the method continues to step S11 where the first offset is clipped to have a value within the interval. Thus, if $\Delta < -t_C$ the first offset is set to have a value of $-t_C$ in step

S11. Correspondingly, if $\Delta > t_C$ then the first offset is set to have a value of t_C in step S11. The method then continues to step S2 of Fig. 2.

[0083] Correspondingly, the modified pixel values calculated in steps S2 and S3 of Fig. 1 could be clipped to be within an allowed interval. This is schematically illustrated by the flow diagram of Fig. 4. The method then continues from step S2 or S3 in Fig. 1 and a next step S20 investigates whether the modified pixel value, i.e. $p0'$ or $q0'$, is within an allowed interval of 0 and M. The parameter M denotes a defined maximum value that the modified pixel values can assume. In a particular embodiment, this maximum value is defined based on the number of bits that are spent on the pixel values. Thus, assume that the pixel values are in the form of a m-bit value, then M is preferably equal to $2^m - 1$. For instance, if each pixel value is a 8-bit value, i.e. $m=8$, then $M=255$. Step S20 therefore investigates whether $0 \leq p0' \leq M$ or $0 \leq q0' \leq M$. If the modified pixel value is within the interval $[0, M]$ the method continues to step S3 of Fig. 1 or ends. However, if the modified pixel value is outside of the interval it is clipped in step S21 to have a value inside the interval. In other words, if $p0' < 0$ or $q0' < 0$ then the modified pixel value is set in step S21 to be $p0' = 0$ or $q0' = 0$. Correspondingly, if $p0' > M$ or $q0' > M$ then step S21 sets the modified pixel value to be $p0' = M$ or $q0' = M$.

[0084] Step S1 of Fig. 1 calculates the first offset to be based on $(9 \times (q0 - p0) - 3 \times (q1 - p1)) / 16$. In a particular embodiment, the first offset is calculated in step S1 to be equal to $(9 \times (q0 - p0) - 3 \times (q1 - p1)) / 16$. In an embodiment, the pixel values are therefore updated by the proposed deblocking filter by using the following calculations:

$$\begin{aligned}\Delta &= (9 \times (q0 - p0) - 3 \times (q1 - p1)) / 16 \\ p0' &= p0 + \Delta \\ q0' &= q0 - \Delta\end{aligned}$$

[0085] Clipping of the first offset and/or the modified pixel values as illustrated in Figs. 3 and 4 can also be used.

[0086] In an alternative embodiment, the offset is calculated as a function of $(9 \times (q_0 - p_0) - 3 \times (q_1 - p_1)) / 16$. Such a function could then be defined so that the calculation of the first offset is efficiently performed in hardware. In such a case, it is generally preferred not to have any divisions and/or define the function so that the first offset will be an integer value. In an embodiment, $(X+8) \gg 4$ is used as an integer-expression of $X/16$, where $\gg$ denotes a right shift operation. Thus, in a particular embodiment step S1 calculates the first offset to be based on and preferably equal to $(9 \times (q_0 - p_0) - 3 \times (q_1 - p_1) + 8) \gg 4$.

[0087] In this embodiment, the pixel values are therefore updated by the proposed deblocking filter by using the following calculations:

$$\begin{aligned}\Delta &= (9 \times (q_0 - p_0) - 3 \times (q_1 - p_1) + 8) \gg 4 \\ p_0' &= p_0 + \Delta \\ q_0' &= q_0 - \Delta\end{aligned}$$

or if clipping is used:

$$\begin{aligned}\Delta &= \text{Clip3}(-t_C, t_C, (9 \times (q_0 - p_0) - 3 \times (q_1 - p_1) + 8) \gg 4) \\ p_0' &= \text{Clip}(p_0 + \Delta) \\ q_0' &= \text{Clip}(q_0 - \Delta)\end{aligned}$$

wherein $\text{Clip3}(A, B, x)$ is defined as $\text{Clip3}(A, B, x) = A$ if $x < A$, $\text{Clip3}(A, B, x) = B$ if $x > B$ and $\text{Clip3}(A, B, x) = x$ if $A \leq x \leq B$ and $\text{Clip}(x)$ is defined as $\text{Clip}(0, M, x)$.

[0088] In alternative embodiments other implementations, such as integer representations of $(9 \times (q_0 - p_0) - 3 \times (q_1 - p_1)) / 16$ and preferably such integer representations that are efficiently implemented in hardware are used.

[0089] The above disclosed embodiments define a deblocking filter that generates a first offset for the pixels closest to the block boundary with a formula that produces approximately

zero, preferably exactly zero, when applied to a ramp of pixel values and which produces an offset value that smoothes a step in the pixel values when applied to a step of pixel values. For instance, a ramp can be described as linearly increasing or decreasing pixel values, e.g. 10, 20, 30, 40. When calculating the first offset for these pixel values, i.e.

$p1 = 10, p0 = 20, q0 = 30, q1 = 40$, the first offset will be zero. Correspondingly, a step can be described as a step increase or decrease in pixel values, e.g. 10, 10, 20, 20. When calculating the first offset for these pixel values, i.e. $p1 = 10, p0 = 10, q0 = 20, q1 = 20$, the first offset will be 3.75 if $\Delta = (9 \times (q0 - p0) - 3 \times (q1 - p1)) / 16$ or 4 if $\Delta = (9 \times (q0 - p0) - 3 \times (q1 - p1) + 8) >> 4$. The modified pixel values will then be 10, 13.75, 16.25, 30 or 10, 14, 16, 20 and thereby a smoothing of the step is achieved. The first offset is also zero for a flat line, i.e. if the pixel values are equal, $p0 = p1 = q0 = q1$.

[0090] In a particular embodiment, also the pixel values of the pixels next closest to the block boundary can be modified. This is described further herein with reference to Figs. 2A, 2B and 5. The method then continues from step S3 of Fig. 1 or from step S2 or indeed step S1. A next step S30 calculates a second offset to be based on $(p2 + p0 - 2 \times p1 + 2 \times \Delta) / 4$, wherein $p2$ denotes the pixel value of the pixel 15 second next closest to the block boundary 1 in the line 12 of pixels 11, 13, 15, 17 in the block 10. A next step S31 calculates a third offset to be based on $(q2 + q0 - 2 \times q1 - 2 \times \Delta) / 4$, wherein $q2$ denotes the pixel value of the pixel 25 second next closest to the block boundary 1 in the corresponding line 22 of pixels 21, 23, 25, 27 in the neighboring block 20. Steps S30 and S31 can be performed sequentially in any order or at least partly in parallel.

[0091] The second offset calculated in step S30 is used in step S32 to modify the pixel value of the pixel 13 next closest to the block boundary 1 in the line 12 of pixels 11, 13, 15, 17. In an embodiment, the second offset is added to the pixel value of this pixel 13 to obtain a modified pixel value. Correspondingly, step S33 modifies the pixel value of the pixel 23 next closest to the block boundary 1 in the corresponding line 22 of pixels 21, 23, 25, 27 by adding the third offset to the pixel value of this pixel 23 to form a modified pixel value. Steps S32 and S33 can be performed in any sequential order or at least partly in parallel.

[0092] The proposed deblocking filter is, in this embodiment, a low-pass filter on all the filter positions $p0, p1, q0, q1$. When applied to a ramp signal, the deblocking filter will not modify it since $\Delta, \Delta_p, \Delta_q$ will all be equal to zero, wherein Δ_p denotes the second offset and Δ_q denotes the third offset. When applied to a step signal, i.e. a deblocking artifact, the deblocking filter will smooth it, i.e. reduce the blocking artifact. In clear contrast to the current HEVC filter, the proposed deblocking filter will smooth and thereby attenuate small ripples on the sides of the block boundary.

[0093] In the above described embodiment, the filters for the coefficients that stand at the second position from the block boundary ($p1, q1$) are produced by using a combination of the first offset and a symmetrical low-pass filter. An advantage of this embodiment is that the offsets for the pixels second next closest to the block boundary can have different values that allows for a better local adaptation. In similar to the first offset, the second and third offsets can be clipped to be within an interval of $-t_{C2}$ and t_{C2} , where the threshold value t_{C2} is determined based on the QP value assigned to the block. In a particular embodiment the threshold value t_{C2} is determined based on the threshold value t_C used for clipping the first offset in Fig. 3. For instance,

$$t_{C2} = \frac{t_C}{2}$$

or with a hardware adapted implementation $t_{C2} = t_C \gg 1$.

[0094] Fig. 6 is a flow diagram illustrating such a clipping of the second and the third offsets. The method continues from step S30 or S31 of Fig. 5. A next step S40 investigates whether the second or third offset is within the interval of $-t_{C2}$ and t_{C2} . If this is true the method continues to step S32 or S33 of Fig. 5. However, if the second or third offset is smaller than $-t_{C2}$ or larger than t_{C2} the method continues to step S41. This step S41 clips the second

or third offset to be $-t_{C2}$ if $\Delta_{p,q} < -t_{C2}$ or sets the second or third offset to t_{C2} if $\Delta_{p,q} > t_{C2}$.

[0095] The modified pixel values of the pixels next closest to the block boundary are preferably clipped to be within the interval of 0 and M in similarity to the modified pixel values for the pixels closest to the block boundary. Hence, the method steps of Fig. 4 can be applied also to these pixels to force the pixel values to be within [0, M].

[0096] In an embodiment, the modified pixel values of the pixels 13, 23 next closest to the block boundary 1 are calculated as:

$$\begin{aligned}\Delta_p &= (p_2 + p_0 - 2 \times p_1 + 2 \times \Delta) / 4 \\ p_1' &= p_1 + \Delta_p \\ \Delta_q &= (q_2 + q_0 - 2 \times q_1 - 2 \times \Delta) / 4 \\ q_1' &= q_1 + \Delta_q\end{aligned}$$

[0097] Optionally clipping of the second and third offsets and/or the modified pixel values as disclosed above are used.

[0098] In alternative embodiment, the computations of the offsets could be performed to be independent of each other.

$$\begin{aligned}\Delta &= (9 \times (q_0 - p_0) - 3 \times (q_1 - p_1) + 8) \gg 4 \\ p_0' &= p_0 + \Delta \\ q_0' &= q_0 - \Delta \\ \Delta_p &= (p_0 + p_2 - 2 \times p_1) / 4 \\ p_1' &= p_1 + \Delta_p + \Delta / 2 \\ \Delta_q &= (q_0 + q_2 - 2 \times q_1) / 4 \\ q_1' &= q_1 + \Delta_q - \Delta / 2\end{aligned}$$

[0099] Mathematically this is equivalent as the previously disclosed embodiment.
Optional clipping can also be performed for this embodiment.

[00100] In an alternative embodiment, the second and third offsets are calculated based on, such as a function, of $(p_2 + p_0 - 2 \times p_1 + 2 \times \Delta)/4$ and $(q_2 + q_0 - 2 \times q_1 - 2 \times \Delta)/4$, respectively. For instance, such function could be adapted for a hardware implementation and/or be an integer representation of $(p_2 + p_0 - 2 \times p_1 + 2 \times \Delta)/4$ and $(q_2 + q_0 - 2 \times q_1 - 2 \times \Delta)/4$. A particular example of such a hardware implementation that produces integer values is to calculate the second offset to be based on, preferably equal to, $((p_2 + p_0 + 1) \gg 1) - p_1 + \Delta \gg 1$. Correspondingly, the third offset is preferably calculated to be based on, preferably equal to, $((q_2 + q_0 + 1) \gg 1) - q_1 - \Delta \gg 1$.

[00101] In such a case, the modified pixel values are calculated as:

$$\begin{aligned}\Delta_p &= (((p_2 + p_0 + 1) \gg 1) - p_1 + \Delta) \gg 1 \\ p_1' &= p_1 + \Delta_p \\ \Delta_q &= (((q_2 + q_0 + 1) \gg 1) - q_1 - \Delta) \gg 1 \\ q_1' &= q_1 + \Delta_q\end{aligned}$$

or if clipping is used:

$$\begin{aligned}\Delta_p &= \text{Clip3}(-t_{C2}, t_{C2}, (((p_2 + p_0 + 1) \gg 1) - p_1 + \Delta) \gg 1) \\ p_1' &= \text{Clip}(p_1 + \Delta_p) \\ \Delta_q &= \text{Clip3}(-t_{C2}, t_{C2}, (((q_2 + q_0 + 1) \gg 1) - q_1 - \Delta) \gg 1) \\ q_1' &= \text{Clip}(q_1 + \Delta_q)\end{aligned}$$

[00102] An alternative embodiment for calculating the second and third offsets, which is adapted for hardware-implementation, is:

$$\Delta_p = \text{Clip3}(-t_{C2}, t_{C2}, ((p2 + p0 - ((p1 - \Delta) \ll 1) + 2) \gg 2))$$

$$\Delta_q = \text{Clip3}(-t_{C2}, t_{C2}, ((q2 + a0 - ((q1 + \Delta) \ll 1) + 2) \gg 2))$$

wherein $\ll$ denotes a left shift operation.

[00103] A further alternative embodiment for calculating the second and third offsets, which is adapted for hardware-implementation, is:

$$\Delta_p = \text{Clip3}(-t_{C2}, t_{C2}, (((p2 + p0 + 1) \gg 1) - p1 + \Delta + 1) \gg 1))$$

$$\Delta_q = \text{Clip3}(-t_{C2}, t_{C2}, (((q2 + q0 + 1) \gg 1) - q1 - \Delta + 1) \gg 1))$$

[00104] In another embodiment, one can use a stronger low-pass filter in combination with the first offset. In this case the second offset is calculated based on, such as equal to,

$(p2 + p0 - 2 \times p1 + \Delta) / 2$ or, in a hardware-adapted implementation, based on, preferably equal to, $((p2 + p0 + 1 + \Delta) \gg 1) - p1$ or alternatively $((p2 + p0 + \Delta - (p1 \ll 1) + 1) \gg 1)$. The third offset could then be calculated based on, such as equal to, $(q2 + q0 - 2 \times q1 - \Delta) / 2$ or, in a hardware-adapted implementation, based on, preferably equal to, $((q2 + q0 + 1 - \Delta) \gg 1) - q1$ or alternatively $((q2 + q0 - \Delta - (q1 \ll 1) + 1) \gg 1)$.

[00105] A particular embodiment calculates the first, second and third offsets for a line of pixels in the block to thereby modify the pixel values of both the pixels closest to the block boundary and the pixels next closest to the block boundary.

[00106] In an alternative embodiment, a decision is first made whether to calculate the second and third offsets and thereby whether to modify the pixel values of the pixels next closest to the block boundary in addition to modifying the pixel values of the pixels closest to the block boundary.

[00107] In similarity to the embodiments disclosed in the foregoing calculating second and third offsets in order to modify the pixel values of the pixels next closest to the block boundary, fourth and fifth offsets can be calculated in order to modify the pixel values of the pixels second next closest to the block boundary.

[00108] Fig. 7 is a flow diagram illustrating such an embodiment. The method continues from step S33 of Fig. 5. A next step S50 calculates a fourth offset based on $(p_3 + p_1 - 2 \times p_2 + 2 \times \Delta_{p1}) / 4$, wherein p_3 denotes the pixel value of the pixel 17 third next closest to the block boundary 1 in the line 12 of pixels 11, 13, 15, 17 in the block 10 and Δ_{p1} denotes the second offset. Step S51 correspondingly calculates a fifth offset to be based on $(q_3 + q_1 - 2 \times q_2 + 2 \times \Delta_{q1}) / 4$, wherein q_3 denotes the pixel value of the pixel 27 third closest to the block boundary 1 in the corresponding line 22 of pixels 21, 23, 25, 27 in the neighboring block 20 and Δ_{q1} denotes the third offset. Steps S50 and S51 can be performed sequentially in any order or at least partly in parallel.

[00109] The fourth and fifth offsets can, in an alternative embodiment, be calculated to be based on $(p_3 + p_1 - 2 \times p_2 + \Delta_{p1}) / 2$ and $(q_3 + q_1 - 2 \times q_2 + \Delta_{q1}) / 2$ respectively, or alternatively $(p_3 + p_1 - 2 \times p_2 + 2 \times \Delta_{p1}) / 4$ and $(q_3 + q_1 - 2 \times q_2 + 2 \times \Delta_{p2}) / 4$.

[00110] The next two steps modify pixel values based on the fourth and fifth offset. Thus, step S52 modifies the pixel value of the pixel 15 second next closest to the block boundary 1 in the line 12 of pixel 11, 13, 15, 17 in the block 10 by adding the fourth offset to the pixel value of this pixel 15 to form a modified pixel value. Step S53 correspondingly modifies the pixel value of the pixel 25 second next closest to the block boundary 1 in the corresponding line 22 of pixels 21, 23, 25, 27 in the neighboring block 20 by adding the fifth offset to the pixel value of this pixel 25 to form a modified pixel value. Steps S52 and S53 can be performed sequentially in any order or at least partly in parallel.

[00111] This concept can also be generalized for the filters modifying more than three pixels from the block boundary. For example, the fourth pixel 17, 27 from the block boundary 1 can be obtained using a combination of the offsets for the third pixels 15, 25 (or the offset from the second pixels 13, 23 or the offset from the first pixels 11, 21) and a symmetrical low-pass filter. Even longer filters are also possible.

[00112] In similarity to the previous embodiments, the fourth and fifth offsets can also be clipped. In such a case, the same interval as for the second and third offsets or half that interval could be used. In an alternative embodiment, the clipping interval is $-t_{C3}$ to t_{C3} , wherein the threshold value t_{C3} is determined based on the QP value associated with the block. Also the modified pixel values of the pixels second next closest to the block boundary can be clipped to be within the interval of 0 and M as disclosed in Fig. 4.

[00113] In a particular embodiment the modification of these pixel values are performed according to below:

$$\begin{aligned}\Delta_{p2} &= (p3 + p1 - 2 \times p2 + 2 \times \Delta_{p1}) / 4 \\ p2' &= p2 + \Delta_{p2} \\ \Delta_{q2} &= (q3 + q1 - 2 \times q2 + 2 \times \Delta_{q1}) / 4 \\ q2' &= q2 + \Delta_{q2}\end{aligned}$$

wherein Δ_{p2}, Δ_{q2} denote the fourth and fifth offsets, respectively. Optionally clipping can be performed as described in the foregoing.

[00114] A representation of $(p3 + p1 - 2 \times p2 + 2 \times \Delta_{p1}) / 4$ and $(q3 + q1 - 2 \times q2 + 2 \times \Delta_{q1}) / 4$ suitable for hardware implementation can be used in order to get the fourth and fifth offsets as integer values. In a particular embodiment, the fourth offset is calculated to be based on, preferably equal to, $((p3 + p1 + 1) \gg 1) - p2 + \Delta_{p1} \gg 1$. Correspondingly, $((q3 + q1 + 1) \gg 1) - q2 + \Delta_{q1} \gg 1$ is an integer representation for the fifth offset.

[00115] The present embodiments are adapted for combating blocking artifacts in connection with coding and decoding of video frames. The embodiments can therefore be applied to such video coding and decoding standards which divide video frames into blocks of pixels and thereby run a risk of having blocking artifacts over block boundaries. Examples of such standards, to which the present embodiments can be applied, are H.264 and HEVC. In particular HEVC, has the possibility to select between a weak filtering mode and a strong filtering mode. The present embodiments can then advantageously be used in the weak filtering mode in order to calculate offsets that are employed to modify the pixel values in a line of pixels and a corresponding line of pixels over a block boundary. Hence, the decisions whether to perform such deblocking filtering according to the prior art HEVC can advantageously be used for the present embodiments.

[00116] A particular aspect relates to a method of reducing blocking artifacts at a block boundary between a block of multiple pixels and a neighboring block of multiple pixels in a video frame. With reference to Fig. 1, the method comprises calculating, in step S1, a first offset based on a pixel value of a pixel closest to the block boundary in a line of pixels in the block, a pixel value of a pixel next closest to the block boundary in the line of pixels, a pixel value of a pixel closest to the block boundary in a corresponding or opposing line of pixels in the neighboring block and a pixel value of a pixel next closest to the block boundary in the corresponding line of pixels. The line of pixels and the neighboring line of pixels are perpendicular to the block boundary. The first offset is calculated based on these pixel values and a formula that produces an offset value that approximates zero, preferably equals zero, when the pixel values are linearly increasing or decreasing or are the same when traveling along the line of pixels and the corresponding line of pixels and produces an offset value that smoothes a step in the pixel values when the pixel values increase or decrease in a step when traveling along the line of pixels and the corresponding line of pixels. The method also comprises modifying, in step S2, the pixel value of the pixel closest to the block boundary in the line of pixels by adding the first offset to the pixel value of the pixel closest to the block boundary in the line of pixels. A next step S3 modifies the pixel value of the pixel closest to the block boundary in the corresponding

line of pixels by subtracting the first offset from the pixel value of the pixel closest to the block boundary in the corresponding line of pixels.

[00117] This particular aspect can be combined with the embodiments discussed in the foregoing in connection with Figs. 1-7.

[00118] The method of reducing blocking artifacts according to the embodiment disclosed in Fig. 1 is preferably performed by a deblocking filter unit. Hence, such a deblocking filter unit then calculates the first offset in step S1 and modifies the pixel values of the pixels closest to the block boundary in steps S2 and S3. Fig. 8 is a schematic block diagram of an embodiment of such a deblocking filter unit 100.

[00119] The deblocking filter unit 100 comprises a first offset calculator 110 configured to calculate a first offset based on $(9 \times (q_0 - p_0) - 3 \times (q_1 - p_1)) / 16$ as previously disclosed herein for a line of pixels in a block of pixels in a video frame. A pixel modifier 120 of the deblocking filter unit 100 is configured to modify the pixel value of a pixel closest to a block boundary in the line of pixels in the block by adding the first offset calculated by the first offset calculator 110 to the pixel value of this pixel to form a modified pixel value. The pixel modifier 120 further modifies the pixel value of a pixel closest to the block boundary but in a corresponding line of pixels in a neighboring block of pixels in the video frame. This modification by the pixel value modifier 120 is achieved by subtracting the first offset calculated by the first offset calculator 110 from the pixel value of this pixel to form a modified pixel value.

[00120] Hence, in a particular embodiment the pixel modifier 120 is configured to add the first offset to the pixel value of the pixel closest to the block boundary in the line of pixels to form a modified pixel value. The pixel modifier 120 is further configured to subtract the first offset from the pixel value of the pixel closest to the block boundary in the corresponding line of pixels to form a modified pixel value.

[00121] In a particular embodiment, the first offset calculator 110 is configured to calculate the first offset to be $f((9 \times (q_0 - p_0) - 3 \times (q_1 - p_1))/16)$, i.e. a function $f(\)$ or representation of $(9 \times (q_0 - p_0) - 3 \times (q_1 - p_1))/16$. This function preferably outputs an integer representation of $(9 \times (q_0 - p_0) - 3 \times (q_1 - p_1))/16$ and preferably the function is suitable for hardware implementation. The first offset calculator 110 is configured, in an embodiment, to calculate the first offset to be based on, preferably equal to,
 $(9 \times (q_0 - p_0) - 3 \times (q_1 - p_1) + 8) \gg 4$.

[00122] Fig. 9 is a schematic block diagram of a deblocking filter unit 200 according to another embodiment. The deblocking filter unit 200 comprises the first offset calculator 210 and the pixel value modifier 220. These units 210, 220 operate as discussed in the foregoing in connection with Fig. 8. The deblocking filter unit 200 preferably also comprises a first clipping unit 230. This first clipping unit 230 is configured to clip the first offset to be within an interval of $-t_C$ and t_C . The threshold value t_C is then dependent on a QP value associated with the block and can, for instance, be selected from Table 1 based on the QP value of the block.

[00123] An optional second clipping unit 240 is implemented in the deblocking filter unit 200 for clipping the modified pixel values calculated by the pixel value modifier 220. Thus, the second clipping unit 240 limits these modified pixel values to be within an interval of zero and the defined maximum value M.

[00124] In a preferred embodiment the deblocking filter unit 200 also comprises a second offset calculator 250 configured to calculate a second offset based on
 $(p_2 + p_0 - 2 \times p_1 + 2 \times \Delta)/4$ for the line of pixels in the block.

[00125] In a particular embodiment, the second offset calculator 250 is configured to calculate the second offset to be $g((p_2 + p_0 - 2 \times p_1 + 2 \times \Delta)/4)$, i.e. a function $g(\)$ or representation of $(p_2 + p_0 - 2 \times p_1 + 2 \times \Delta)/4$. This function preferably outputs an integer representation of $(p_2 + p_0 - 2 \times p_1 + 2 \times \Delta)/4$ and preferably the function is suitable for

hardware implementation. The second offset calculator 250 is configured, in an embodiment, to calculate the second offset to be based on, preferably equal to,

$$(((p_2 + p_0 + 1) \gg 1) - p_1 + \Delta) \gg 1.$$

[00126] The deblocking filter unit 200 preferably comprises a third offset calculator 260 configured to calculate a third offset based on $(q_2 + q_0 - 2 \times q_1 - 2 \times \Delta)/4$ for the corresponding line of pixels in the neighboring block.

[00127] In a particular embodiment, the third offset calculator 260 is configured to calculate the third offset to be $h((q_2 + q_0 - 2 \times q_1 - 2 \times \Delta)/4)$, i.e. a function $h(\)$ or representation of $(q_2 + q_0 - 2 \times q_1 - 2 \times \Delta)/4$. This function preferably outputs an integer representation of $(q_2 + q_0 - 2 \times q_1 - 2 \times \Delta)/4$ and preferably function is suitable for hardware implementation. The third offset calculator 260 is configured, in an embodiment, to calculate the third offset to be based on, preferably equal to, $((q_2 + q_0 + 1) \gg 1) - q_1 - \Delta) \gg 1$.

[00128] The pixel modifier 220 of the deblocking filter unit 200 is then furthermore configured to modify the pixel value of the pixel next closest to the block boundary in the line of pixels in the block. The pixel modifier 220 adds the second offset calculated by the second offset calculator 250 to the pixel value of this pixel. The pixel modifier 220 is additionally configured to modify the pixel value of the pixel next closest to the block boundary but in the corresponding line of pixels in the neighboring block. This modification is achieved by adding the third offset calculated by the third offset calculator 260 to the pixel value of this pixel.

[00129] An optional third clipping unit 270 of the deblocking filter unit 200 is configured to clip the second offset calculated by the second offset calculator 250 and the third offset calculated by the third offset calculator 260 to be within an interval of $-t_{C2}$ and t_{C2} . The threshold value t_{C2} is preferably dependent on the QP value associated with the block and is advantageous calculated based on the threshold value t_C used for clipping the first offset. In an

alternative embodiment, the third clipping unit 270 is omitted and any clipping of the second and third offsets is instead performed by the first clipping unit 230.

[00130] The second clipping unit 240 preferably not only clips the modified pixel values of the pixels closest to the block boundary but also the modified pixel values of the pixels next closest to the block boundary and calculated using the second and third offsets, respectively. Thus, also these modified pixel values are preferably restricted to be within the interval of zero to the defined maximum value M.

[00131] The second offset calculator 250 and the third offset calculator 260 could be configured to calculate the second and third offsets for each line of pixels and each corresponding line of pixels for which deblocking filtering is to be applied over the block boundary between the block and the neighboring block. In an alternative approach the deblocking filter unit 200 performs a selection whether to only calculate the first offset and thereby only modify the pixel values of the pixels closest to the block boundary or to calculate both the first, second and third offsets and thereby modify the pixel values of the pixels closest to and the pixels next closest to the block boundary.

[00132] In an optional embodiment, the deblocking filter unit 200 can comprise a fourth offset calculator 280 configured to calculate a fourth offset to be based on $(p_3 + p_1 - 2 \times p_2 + 2 \times \Delta_{p1}) / 4$.

[00133] In a particular embodiment, the fourth offset calculator 280 is configured to calculate the fourth offset to be $b((p_3 + p_1 - 2 \times p_2 + 2 \times \Delta_{p1}) / 4)$, i.e. a function $b(\)$ or representation of $(p_3 + p_1 - 2 \times p_2 + 2 \times \Delta_{p1}) / 4$. This function preferably outputs an integer representation of $(p_3 + p_1 - 2 \times p_2 + 2 \times \Delta_{p1}) / 4$ and preferably the function is suitable for hardware implementation. The fourth offset calculator 280 is configured, in an embodiment, to calculate the fourth offset to be based on, preferably equal to, $((p_3 + p_1 + 1) \gg 1) - p_2 + \Delta_{p1} \gg 1$.

[00134] The deblocking filter 200 could also comprise an optional fifth offset calculator 290 configured to calculate a fifth offset to be based on $(q_3 + q_1 - 2 \times q_2 + 2 \times \Delta_{q_1}) / 4$.

[00135] In a particular embodiment, the fifth offset calculator 290 is configured to calculate the fifth offset to be $k((q_3 + q_1 - 2 \times q_2 + 2 \times \Delta_{q_1}) / 4)$, i.e. a function $k(\)$ or representation of $(q_3 + q_1 - 2 \times q_2 + 2 \times \Delta_{q_1}) / 4$. This function preferably outputs an integer representation of $(q_3 + q_1 - 2 \times q_2 + 2 \times \Delta_{q_1}) / 4$ and preferably the function is suitable for hardware implementation. The fifth offset calculator 290 is configured, in an embodiment, to calculate the fifth offset to be based on, preferably equal to, $((q_3 + q_1 + 1) >> 1) - q_2 + \Delta_{q_1} >> 1$.

[00136] In this embodiment, the pixel value modifier 220 is also configured to modify the pixel value of the pixel second next closest to the block boundary in the line of pixels in the block by adding the fourth offset calculated by the fourth offset calculator 280 to the pixel value of this pixel. The pixel value modifier 220 additionally modifies, in this embodiment, the pixel value of the pixel second next closest to the block boundary in the corresponding line of pixels in the neighboring block by adding the fifth offset calculated by the fifth offset calculator to the pixel value of this pixel.

[00137] The second clipping unit 240 preferably processes the modified pixel values to restrict them within the interval of zero and the predefined maximum value M. The third clipping unit 270 can also be used to clip the fourth and fifth offsets in similarity to the second and third offsets. Alternatively, the deblocking filter unit 200 comprises a fourth clipping unit configured to clip the fourth and fifth offsets to be within an interval having end points that are defined based on the QP value of the block and preferably based on the threshold value t_C .

[00138] A particular aspect relates to a deblocking filter unit for reducing blocking artifacts at a block boundary between a block of multiple pixels and a neighboring block of multiple pixels in a video frame. With reference to Fig. 8, the deblocking filter unit 100

comprises a first offset calculator 110 configured to calculate a first offset based on a pixel value of a pixel closest to the block boundary in a line of pixels in the block, a pixel value of a pixel next closest to the block boundary in the line of pixels, a pixel value of a pixel closest to the block boundary in a corresponding or opposing line of pixels in the neighboring block and a pixel value of a pixel next closest to the block boundary in the corresponding line of pixels. The line of pixels and the neighboring line of pixels are perpendicular to the block boundary. The first offset is calculated by the first offset calculator 110 based on these pixel values and a formula that produces an offset value that approximates zero, preferably equals zero, when the pixel values are linearly increasing or decreasing or are the same when traveling along the line of pixels and the corresponding line of pixels and produces an offset value that smoothes a step in the pixel values when the pixel values increase or decrease in a step when traveling along the line of pixels and the corresponding line of pixels. The deblocking filter unit 100 also comprises a pixel value modifier 120 configured to modify the pixel value of the pixel closest to the block boundary in the line of pixels by adding the first offset to the pixel value of the pixel closest to the block boundary in the line of pixels to form a modified pixel value. The pixel value modifier 120 is further configured to modify the pixel value of the pixel closest to the block boundary in the corresponding line of pixels by subtracting the first offset from the pixel value of the pixel closest to the block boundary in the corresponding line of pixels to form a modified pixel value.

[00139] Although the respective unit 110, 120 and 210-290 disclosed in conjunction with Figs. 8 and 9 have been disclosed as physically separate units 110, 120 and 210-290 in the device 100, 200, and all may be special purpose circuits, such as ASICs (Application Specific Integrated Circuits), alternative embodiments of the device 100, 200 are possible where some or all of the units 110, 120 and 210-290 are implemented as computer program modules running on a general purpose processor. Such an embodiment is disclosed in Fig. 10.

[00140] Fig. 10 schematically illustrates an embodiment of a computer 70 having a processing unit 72, such as a DSP (Digital Signal Processor) or CPU (Central Processing Unit). The processing unit 72 can be a single unit or a plurality of units for performing different steps of the method described herein. The computer 70 also comprises an input/output (I/O) unit 71 for receiving recorded or generated video frames or encoded video frames and encoded video frame

or decoded video data. The I/O unit 71 has been illustrated as a single unit in Fig. 10 but can likewise be in the form of a separate input unit and a separate output unit.

[00141] Furthermore, the computer 70 comprises at least one computer program product 73 in the form of a non-volatile memory, for instance an EEPROM (Electrically Erasable Programmable Read-Only Memory), a flash memory or a disk drive. The computer program product 73 comprises a computer program 74, which comprises code means which when run on the computer 70, such as by the processing unit 72, causes the computer 70 to perform the steps of the method described in the foregoing in connection with Fig. 1. Hence, in an embodiment the code means in the computer program 74 comprises a first offset calculating module or first offset calculator 310 for calculating the first offset and a pixel value modifying module or a pixel value modifier 320 for modifying pixel values of a deblocking filter module 300 or deblocking filter device. These modules 310, 320 essentially perform the steps of the flow diagram in Fig. 1 when run on the processing unit 72. Thus, when the different modules 310, 320 are run on the processing unit 72 they correspond to the corresponding units 110, 120 of Fig. 8 and units 210, 220 of Fig. 9.

[00142] The computer program 74 may additionally comprise a first clipping module, a second clipping module, a second offset calculating module, a third offset calculating module and optionally also a third clipping module, a fourth offset calculating module and a fifth offset calculating module to perform the operation of the corresponding units 230-290 in Fig. 9.

[00143] The computer 70 of Fig. 10 can be a user equipment or be present in a user equipment 80. In such a case, the user equipment 80 may additionally comprise or be connected to a display 88 to display video data.

[00144] The deblocking filter unit 100, 200 of Figs. 8 and 9 is preferably used in video coding. It functions and is therefore preferably implemented both in a video encoder and in a video decoder. The video decoder can be implemented preferably in hardware but also in software. The same holds for the video encoder.

[00145] Fig. 11 is a schematic block diagram of an encoder 40 for encoding a block of pixels in a video frame of a video sequence according to an embodiment.

[00146] A current block of pixels is predicted by performing a motion estimation by a motion estimator 50 from an already provided block of pixels in the same frame or in a previous frame. The result of the motion estimation is a motion or displacement vector associated with the reference block, in the case of inter prediction. The motion vector is utilized by a motion compensator 50 for outputting an inter prediction of the block of pixels.

[00147] An intra predictor 49 computes an intra prediction of the current block of pixels. The outputs from the motion estimator/compensator 50 and the intra predictor 49 are input in a selector 51 that either selects intra prediction or inter prediction for the current block of pixels. The output from the selector 51 is input to an error calculator in the form of an adder 41 that also receives the pixel values of the current block of pixels. The adder 41 calculates and outputs a residual error as the difference in pixel values between the block of pixels and its prediction.

[00148] The error is transformed in a transformer 42, such as by a discrete cosine transform, and quantized by a quantizer 43 followed by coding in an encoder 44, such as by entropy encoder. In inter coding, also the estimated motion vector is brought to the encoder 44 for generating the coded representation of the current block of pixels.

[00149] The transformed and quantized residual error for the current block of pixels is also provided to a inverse quantizer 45 and inverse transformer 46 to retrieve the original residual error. This error is added by an adder 47 to the block prediction output from the motion compensator 50 or the intra predictor 49 to create a reference block of pixels that can be used in the prediction and coding of a next block of pixels. This new reference block is first processed by a deblocking filter unit 100 according to the embodiments in order to perform deblocking filtering to combat any blocking artifact. The processed new reference block is then temporarily stored in a frame buffer 48, where it is available to the intra predictor 49 and the motion estimator/compensator 50.

[00150] Fig. 12 is a corresponding schematic block diagram of a decoder 60 comprising a deblocking filter unit 100 according to the embodiments. The decoder 60 comprises a decoder 61, such as entropy decoder, for decoding an encoded representation of a block of pixels to get a set of quantized and transformed residual errors. These residual errors are dequantized in an inverse quantizer 62 and inverse transformed by an inverse transformer 63 to get a set of residual errors.

[00151] These residual errors are added in an adder 64 to the pixel values of a reference block of pixels. The reference block is determined by a motion estimator/compensator 67 or intra predictor 66, depending on whether inter or intra prediction is performed. A selector 68 is thereby interconnected to the adder 64 and the motion estimator/compensator 67 and the intra predictor 66. The resulting decoded block of pixels output from the adder 64 is input to a deblocking filter unit 100 according to the embodiments in order to deblocking filter any blocking artifacts. The filtered block of pixels is output from the decoder 60 and is furthermore preferably temporarily provided to a frame buffer 65 and can be used as a reference block of pixels for a subsequent block of pixels to be decoded. The frame buffer 65 is thereby connected to the motion estimator/compensator 67 to make the stored blocks of pixels available to the motion estimator/compensator 67.

[00152] The output from the adder 64 is preferably also input to the intra predictor 66 to be used as an unfiltered reference block of pixels.

[00153] In the embodiments disclosed in Figs. 11 and 12 the deblocking filter unit 100 performs deblocking filtering as so called in-loop filtering. In an alternative implementation at the decoder 60 the deblocking filter unit 100 is arranged to perform so called post-processing filtering. In such a case, the deblocking filter unit 100 operates on the output frames outside of the loop formed by the adder 64, the frame buffer 65, the intra predictor 66, the motion estimator/compensator 67 and the selector 68. No deblocking filtering is then typically done at the encoder.

[00154] Fig. 13 is a schematic block diagram of a user equipment or media terminal 80 housing a decoder 60 with a deblocking filter unit. The user equipment 80 can be any device having media decoding functions that operates on an encoded video stream of encoded video frames to

thereby decode the video frames and make the video data available. Non-limiting examples of such devices include mobile telephones and other portable media players, tablets, desktops, notebooks, personal video recorders, multimedia players, video streaming servers, set-top boxes, TVs, computers, decoders, game consoles, etc. The user equipment 80 comprises a memory 84 configured to store encoded video frames. These encoded video frames can have been generated by the user equipment 80 itself. In such a case, the user equipment 80 preferably comprises a media engine or recorder together with a connected encoder, such as the encoder of Fig. 11. Alternatively, the encoded video frames are generated by some other device and wirelessly transmitted or transmitted by wire to the user equipment 80. The user equipment 80 then comprises a transceiver (transmitter and receiver) or input and output port 82 to achieve the data transfer.

[00155] The encoded video frames are brought from the memory 84 to a decoder 60, such as the decoder illustrated in Fig. 12. The decoder 60 comprises a deblocking filter unit 100 according to embodiments. The decoder 60 then decodes the encoded video frames into decoded video frames. The decoded video frames are provided to a media player 86 that is configured to render the decoded video frames into video data that is displayable on a display or screen 88 of or connected to the user equipment 80.

[00156] In Fig. 13, the user equipment 80 has been illustrated as comprising both the decoder 60 and the media player 86, with the decoder 60 implemented as a part of the media player 86. This should, however, merely be seen as an illustrative but non-limiting example of an implementation embodiment for the user equipment 80. Also distributed implementations are possible where the decoder 60 and the media player 86 are provided in two physically separated devices are possible and within the scope of user equipment 80 as used herein. The display 88 could also be provided as a separate device connected to the user equipment 80, where the actual data processing is taking place.

[00157] As illustrated in Fig. 14, the encoder 40 and/or decoder 60, such as illustrated in Figs. 11 and 12, may be implemented in a network device 30 being or belonging to a network node in a communication network 32 between a sending unit 34 and a receiving user equipment 36. Such a network device 30 may be a device for converting video according to one video coding standard

to another video coding standard, for example, if it has been established that the receiving user equipment 36 is only capable of or prefers another video coding standard than the one sent from the sending unit 34. The network device 30 can be in the form of or comprised in a radio base station, a Node-B or any other network node in a communication network 32, such as a radio-based network.

[00158] The embodiments described above are to be understood as a few illustrative examples of the present invention. It will be understood by those skilled in the art that various modifications, combinations and changes may be made to the embodiments without departing from the scope of the present invention. In particular, different part solutions in the different embodiments can be combined in other configurations, where technically possible. The scope of the present invention is, however, defined by the appended claims.

CLAIMS:

1. A method of reducing blocking artifacts at a block boundary between a block of multiple pixels and a neighboring block of multiple pixels in a video frame, said method comprises:

calculating a first offset to be equal to $(9 \times (q_0 - p_0) - 3 \times (q_1 - p_1) + 8) \gg 4$, wherein $\gg$ denotes a right shift operation, p_0 denotes a pixel value of a pixel closest to said block boundary in a line of pixels in said block, wherein said line of pixels is perpendicular to said block boundary, p_1 denotes a pixel value of a pixel next closest to said block boundary in said line of pixels, q_0 denotes a pixel value of a pixel closest to said block boundary in a corresponding line of pixels in said neighboring block, wherein said corresponding line of pixels is perpendicular to said block boundary and q_1 denotes a pixel value of a pixel next closest to said block boundary in said corresponding line of pixels;

modifying said pixel value p_0 of said pixel closest to said block boundary in said line of pixels by adding said first offset to said pixel value p_0 of said pixel closest to said block boundary in said line of pixels to form a modified pixel value p_0' of said pixel closest to said block boundary in said line of pixels; and

modifying said pixel value q_0 of said pixel closest to said block boundary in said corresponding line of pixels by subtracting said first offset from said pixel value q_0 of said pixel closest to said block boundary in said corresponding line of pixels to form a modified pixel value q_0' of said pixel closest to said block boundary in said corresponding line of pixels.

2. The method according to claim 1, further comprising clipping said first offset to be within an interval of $-t_c$ and t_c by setting said first offset to be equal to $-t_c$ if said first offset is smaller than $-t_c$ and by setting said first offset to be equal to t_c if said first offset is larger than t_c , wherein t_c is a threshold value that is dependent on a quantization parameter value assigned to said block.

3. The method according to claim 1, further comprising:

clipping said modified pixel value p_0' of said pixel closest to said block boundary in said line of pixels to be within an interval of zero and a defined maximum value by setting said

modified pixel value $p0'$ of said pixel closest to said block boundary in said line of pixels to be equal to zero if said modified pixel value $p0'$ of said pixel closest to said block boundary in said line of pixels is smaller than zero and by setting said modified pixel value $p0'$ of said pixel closest to said block boundary in said line of pixels to be equal to said defined maximum value if said modified pixel value $p0'$ of said pixel closest to said block boundary in said line of pixels is larger than said defined maximum value; and

clipping said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels to be within an interval of zero and said defined maximum value by setting said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels to be equal to zero if said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels is smaller than zero and by setting said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels to be equal to said defined maximum if said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels is larger than said defined maximum value.

4. The method according to claim 1, further comprising:

calculating a second offset to be based on $(p2+p0=2 \times p1+2 \times \Delta)/4$, wherein $p2$ denotes a pixel value of a pixel second next closest to said block boundary in said line of pixels and A denotes said first offset;

calculating a third offset to be based on $(q2+q0-2 \times q1-2 \times \Delta)/4$, wherein $q2$ denotes a pixel value of a pixel second next closest to said block boundary in said corresponding line of pixels;

modifying said pixel value $p1$ of said pixel next closest to said block boundary in said line of pixels by adding said second offset to said pixel value $p1$ of said pixel next closest to said block boundary in said line of pixels to form a modified pixel value $p1'$ of said pixel next closest to said block boundary in said line of pixels; and

modifying said pixel value $q1$ of said pixel next closest to said block boundary in said corresponding line of pixels by adding said third offset to said pixel value $q1$ of said pixel next closest to said block boundary in said corresponding line of pixels to form a modified pixel value $q1'$ of said pixel next closest to said block boundary in said corresponding line of pixels.

5. The method according to claim 4, wherein

calculating said second offset comprises calculating said second offset to be equal to $((p_2+p_0+1)\gg 1)-p_1+\Delta)\gg 1$, wherein $\gg$ denotes a right shift operation; and

calculating said third offset comprises calculating said third offset to be equal to $((q_2+q_0+1)\gg 1)-q_1-\Delta)\gg 1$.

6. The method according to claim 4, further comprising:

clipping said second offset to be within an interval of $-t_{C2}$ and t_{C2} by setting said second offset to be equal to $-t_{C2}$ if said second offset is smaller than $-t_{C2}$ and by setting said second offset to be equal to t_{C2} if said second offset is larger than t_{C2} , wherein t_{C2} is a threshold value that is dependent on a quantization parameter value assigned to said block; and

clipping said third offset within an interval of $-t_{C2}$ and t_{C2} by setting said third offset to be equal to $-t_{C2}$ if said third offset is smaller than $-t_{C2}$ and by setting said third offset to be equal to t_{C2} if said third offset is larger than t_{C2} .

7. The method according to claim 4, further comprising:

clipping said modified pixel value p_1' of said pixel next closest to said block boundary in said line of pixels to be within an interval of zero and a defined maximum value by setting said modified pixel value p_1' of said pixel next closest to said block boundary in said line of pixels to be equal to zero if said modified pixel value p_1' of said pixel next closest to said block boundary in said line of pixels is smaller than zero and by setting said modified pixel value p_1' of said pixel next closest to said block boundary in said line of pixels to be equal to said defined maximum value if said modified pixel value p_1' of said pixel next closest to said block boundary in said line of pixels is larger than said defined maximum value; and

clipping said modified pixel value q_1' of said pixel next closest to said block boundary in said corresponding line of pixels to be within an interval of zero and said defined maximum value by setting said modified pixel value q_1' of said pixel next closest to said block boundary in said corresponding line of pixels to be equal to zero if said modified pixel value q_1' of said pixel next closest to said block boundary in said corresponding line of pixels is smaller than zero and by setting said modified pixel value q_1' of said pixel next closest to said block boundary in said corresponding line of pixels to be equal to said defined maximum if said modified pixel value q_1'

of said pixel next closest to said block boundary in said corresponding line of pixels is larger than said defined maximum value.

8. The method according to claim 4, further comprising:

calculating a fourth offset to be based on $(p_3+p_1-2\times p_2+2\times \Delta_{p1})/4$, wherein p_3 denotes a pixel value of a pixel third next closest to said block boundary in said line of pixels and Δ_{p1} denotes said second offset; and

calculating a fifth offset to be based on $(q_3+q_1-2\times q_2+2\times \Delta_{q1})/4$, wherein q_3 denotes a pixel value of a pixel third closest to said block boundary in said corresponding line of pixels and Δ_{q1} denotes said third offset;

modifying said pixel value p_2 of said pixel second next closest to said block boundary in said line of pixels by adding said fourth offset to said pixel value p_2 of said pixel second next closest to said block boundary in said line of pixels to form a modified pixel value p_2' of said pixel second next closest to said block boundary in said line of pixels; and

modifying said pixel value q_2 of said pixel second next closest to said block boundary in said corresponding line of pixels by adding said fifth offset to said pixel value q_2 of said pixel second next closest to said block boundary in said corresponding line of pixels to form a modified pixel value q_2' of said pixel second next closest to said block boundary in said corresponding line of pixels.

9. The method according to claim 8, wherein

calculating said fourth offset comprises calculating said fourth offset to be equal to $((p_3+p_1+1)>>1)-p_2+\Delta_{p1})1$, wherein $>>$ denotes a right shift operation; and

calculating said fifth offset comprises calculating said fifth offset to be equal to $((q_3+q_1+1)>>1)-q_2+\Delta_{q1})>>1$.

10. A user equipment comprising a deblocking filter unit for reducing blocking artifacts at a block boundary between a block of multiple pixels and a neighboring block of multiple pixels in a video frame, wherein the deblocking filter unit comprises:

a first offset calculator configured to calculate a first offset to be equal to $(9 \times (q_0 - p_0) - 3 \times (q_1 - p_1) + 8) \gg 4$, wherein $\gg$ denotes a right shift operation, p_0 denotes a pixel value of a pixel closest to said block boundary in a line of pixels in said block, wherein said line of pixels is perpendicular to said block boundary, p_1 denotes a pixel value of a pixel next closest to said block boundary in said line of pixels, q_0 denotes a pixel value of a pixel closest to said block boundary in a corresponding line of pixels in said neighboring block, wherein said corresponding line of pixels is perpendicular to said block boundary, and q_1 denotes a pixel value of a pixel next closest to said block boundary in said corresponding line of pixels; and

a pixel value modifier configured to modify said pixel value p_0 of said pixel closest to said block boundary in said line of pixels by adding said first offset to said pixel value p_0 of said pixel closest to said block boundary in said line of pixels to form a modified pixel value p_0' of said pixel closest to said block boundary in said line of pixels and to modify said pixel value q_0 of said pixel closest to said block boundary in said corresponding line of pixels by subtracting said first offset from said pixel value q_0 of said pixel closest to said block boundary in said corresponding line of pixels to form a modified pixel value q_0' of said pixel closest to said block boundary in said corresponding line of pixels.

11. The user equipment according to claim 10, wherein the deblocking filter unit further comprises a first clipping unit configured to clip said first offset within an interval of $-t_c$ and t_c by setting said first offset to be equal to $-t_c$ if said first offset is smaller than $-t_c$ and by setting said first offset to be equal to t_c if said first offset is larger than t_c , wherein t_c is a threshold value that is dependent on a quantization parameter value assigned to said block.

12. The user equipment according to claim 10, wherein the deblocking filter unit further comprises a second clipping unit configured to clip said modified pixel value p_0' of said pixel closest to said block boundary in said line of pixels to be within an interval of zero and a defined maximum value by setting said modified pixel value p_0' of said pixel closest to said block boundary in said line of pixels to be equal to zero if said modified pixel value p_0' of said pixel

closest to said block boundary in said line of pixels is smaller than zero and by setting said modified pixel value $p0'$ of said pixel closest to said block boundary in said line of pixels to be equal to said defined maximum value if said modified pixel value $p0'$ of said pixel closest to said block boundary in said line of pixels is larger than said defined maximum value and to clip said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels to be within an interval of zero and said defined maximum value by setting said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels to be equal to zero if said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels is smaller than zero and by setting said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels to be equal to said defined maximum if said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels is larger than said defined maximum value.

13. The user equipment according to claim 10, wherein the deblocking filter unit further comprises:

a second offset calculator configured to calculate a second offset to be based on $(p2+p0-2 \times p1+2 \times \Delta)/4$, wherein $p2$ denotes a pixel value of a pixel second next closest to said block boundary in said line of pixels and Δ denotes said first offset; and

a third offset calculator configured to calculate a third offset to be based on $(q2+q0-2 \times q1-2 \times \Delta)/4$, wherein $q2$ denotes a pixel value of a pixel second next closest to said block boundary in said corresponding line of pixels,

wherein said pixel value modifier is configured to modify said pixel value $p2$ of said pixel second next closest to said block boundary in said line of pixels by adding said second offset to said pixel value $p2$ of said pixel second next closest to said block boundary in said line of pixels to form a modified pixel value $p2'$ of said pixel second next closest to said block boundary in said line of pixels and to modify said pixel value $q2$ of said pixel second next closest to said block boundary in said corresponding line of pixels by adding said third offset to said pixel value $q2$ of said pixel second next closest to said block boundary in said corresponding line of pixels to form a modified pixel value $q2'$ of said pixel second next closest to said block boundary in said corresponding line of pixels.

14. The user equipment according to claim 13, wherein
said second offset calculator is configured to calculate said second offset to be equal to $((p_2 + p_0 + 1) \gg 1) - p_1 + \Delta \gg 1$, wherein $\gg$ denotes a right shift operation; and
said third offset calculator is configured to calculate said third offset to be equal to $((q_2 + q_0 + 1) \gg 1) - q_1 - \Delta \gg 1$.

15. The user equipment according to claim 13, wherein the deblocking filter unit further comprises a third clipping unit configured to clip said second offset to be within an interval of $-t_{C2}$ and t_{C2} by setting said second offset to be equal to $-t_{C2}$ if said second offset is smaller than $-t_{C2}$ and by setting said second offset to be equal to t_{C2} if said second offset is larger than t_{C2} , wherein t_{C2} is a threshold value that is dependent on a quantization parameter value assigned to said block, and to clip said third offset within an interval of $-t_{C2}$ and t_{C2} by setting said third offset to be equal to $-t_{C2}$ if said third offset is smaller than $-t_{C2}$ and by setting said third offset to be equal to t_{C2} if said third offset is larger than t_{C2} .

16. The user equipment according to claim 13, wherein the user equipment further comprises a second clipping unit configured to clip said modified pixel value p_1' of said pixel next closest to said block boundary in said line of pixels to be within an interval of zero and a defined maximum value by setting said modified pixel value p_1' of said pixel next closest to said block boundary in said line of pixels to be equal to zero if said modified pixel value p_1' of said pixel next closest to said block boundary in said line of pixels is smaller than zero and by setting said modified pixel value p_1' of said pixel next closest to said block boundary in said line of pixels to be equal to said defined maximum value if said modified pixel value p_1' of said pixel next closest to said block boundary in said line of pixels is larger than said defined maximum value, and to clip said modified pixel value q_1' of said pixel next closest to said block boundary in said corresponding line of pixels to be within an interval of zero and said defined maximum value by setting said modified pixel value q_1' of said pixel next closest to said block boundary in said corresponding line of pixels to be equal to zero if said modified pixel value q_1' of said pixel next closest to said block boundary in said corresponding line of pixels is smaller than zero and by setting said modified pixel value q_1' of said pixel next closest to said block boundary in said corresponding line of pixels to be equal to said defined maximum if said modified pixel value q_1'

of said pixel next closest to said block boundary in said corresponding line of pixels is larger than said defined maximum value.

17. The user equipment according to claim 13, wherein the deblocking filter unit further comprises:

a fourth offset calculator configured to calculate a fourth offset to be based on $(p_3 + p_1 - 2 \times p_2 + 2 \times \Delta_{p1})/4$, wherein p_3 denotes a pixel value of a pixel third next closest to said block boundary in said line of pixels and Δ_{p1} denotes said second offset; and a fifth offset calculator configured to calculate a fifth offset to be based on $(q_3 + q_1 - 2 \times q_2 + 2 \times \Delta_{q1})/4$, wherein q_3 denotes a pixel value of a pixel third closest to said block boundary in said corresponding line of pixels and Δ_{q1} denotes said third offset,

wherein said pixel value modifier is configured to modify said pixel value p_2 of said pixel second next closest to said block boundary in said line of pixels by adding said fourth offset to said pixel value p_2 of said pixel second next closest to said block boundary in said line of pixels to form a modified pixel value p_2' of said pixel second next closest to said block boundary in said line of pixels, and to modify said pixel value q_2 of said pixel second next closest to said block boundary in said corresponding line of pixels by adding said fifth offset to said pixel value q_2 of said pixel second next closest to said block boundary in said corresponding line of pixels to form a modified pixel value q_2' of said pixel second next closest to said block boundary in said corresponding line of pixels.

18. The user equipment according to claim 17, wherein

said fourth offset calculator is configured to calculate calculating said fourth offset to be equal to $((p_3 + p_1 + 1) \gg 1) - p_2 + \Delta_{p1} \gg 1$, wherein $\gg$ denotes a right shift operation; and

said fifth offset calculator is configured to calculate said fifth offset to be equal to $((q_3 + q_1 + 1) \gg 1) - q_2 + \Delta_{q1} \gg 1$.

ABSTRACT

Blocking artifacts at a block boundary between a block and a neighboring block in a video frame are reduced by calculating an offset based on pixel values of pixels in a line of pixels in the block and based on pixel values of pixels in a corresponding line of pixels in the neighboring block. The offset is added to the pixel value of the pixel closest to the block boundary in the line of pixels and is subtracted from the pixel value of the pixel closest to the block boundary in the corresponding line of pixels. The resulting deblocking filter has good low-pass characteristics and is efficient for reducing blocking artifact.

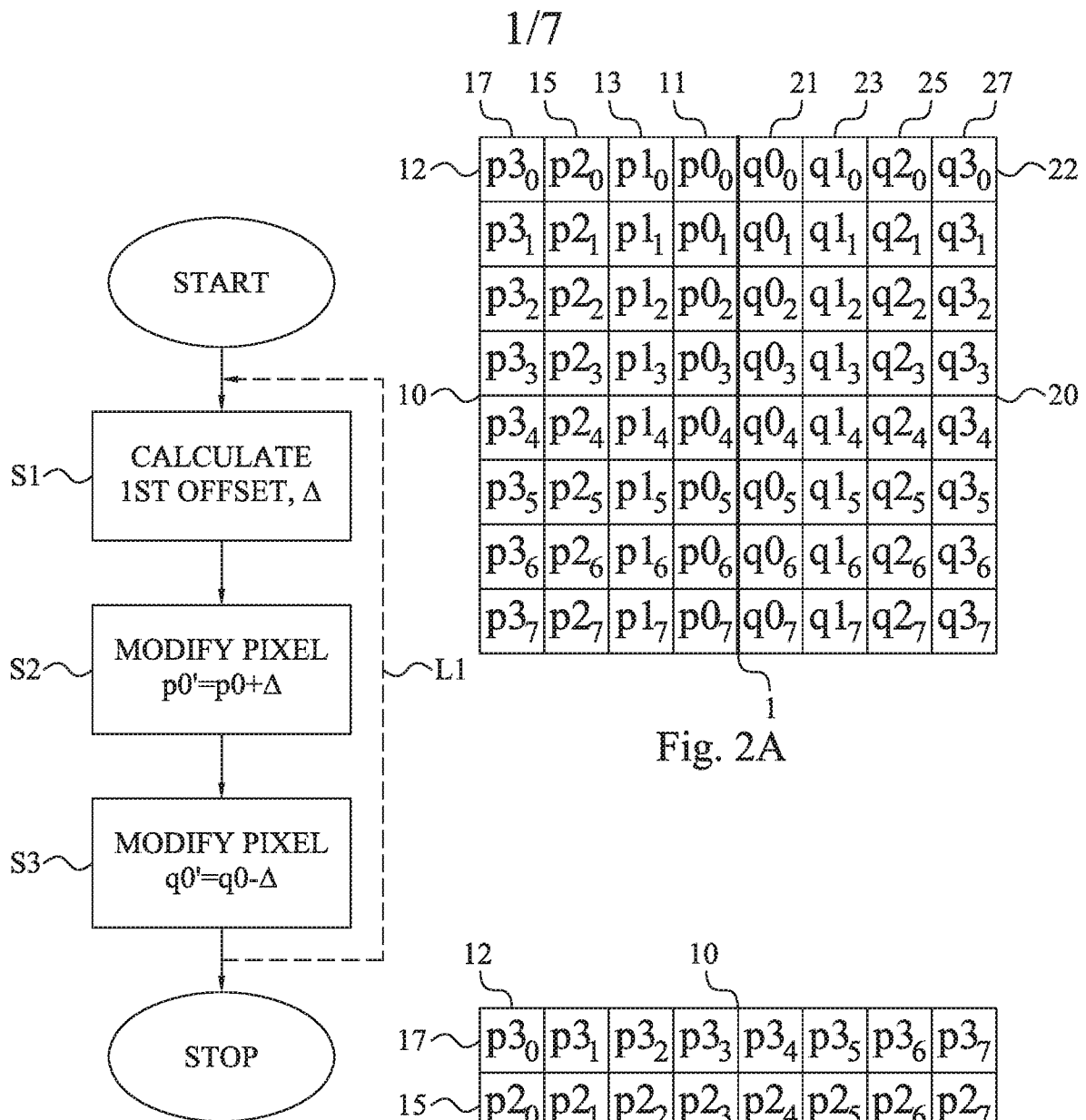


Fig. 1

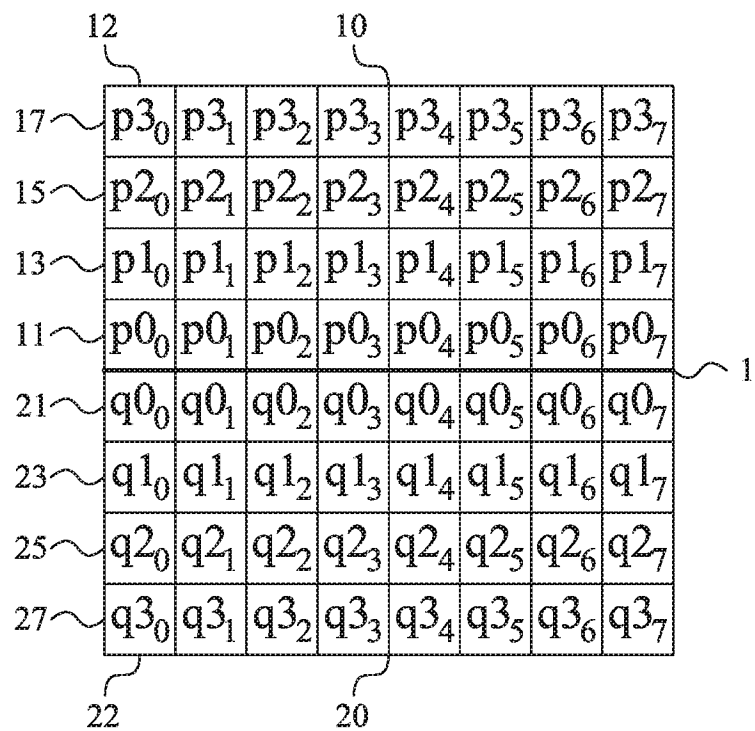


Fig. 2B

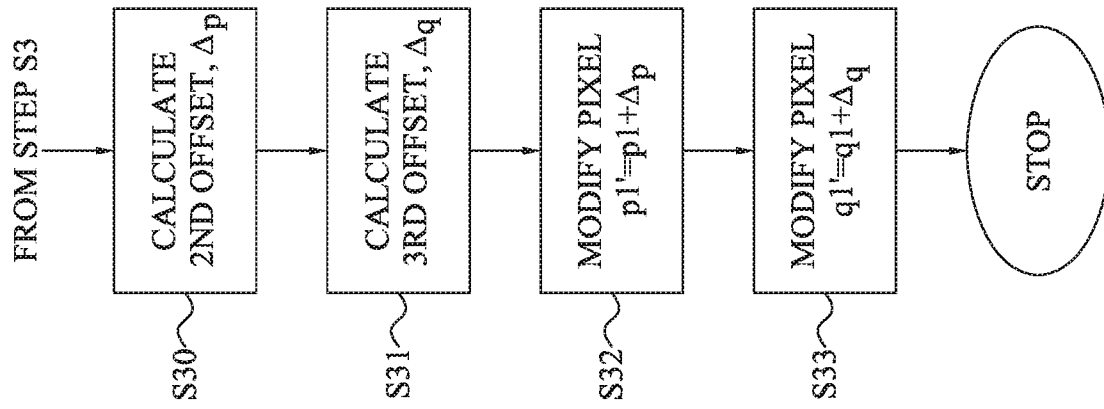


Fig. 5

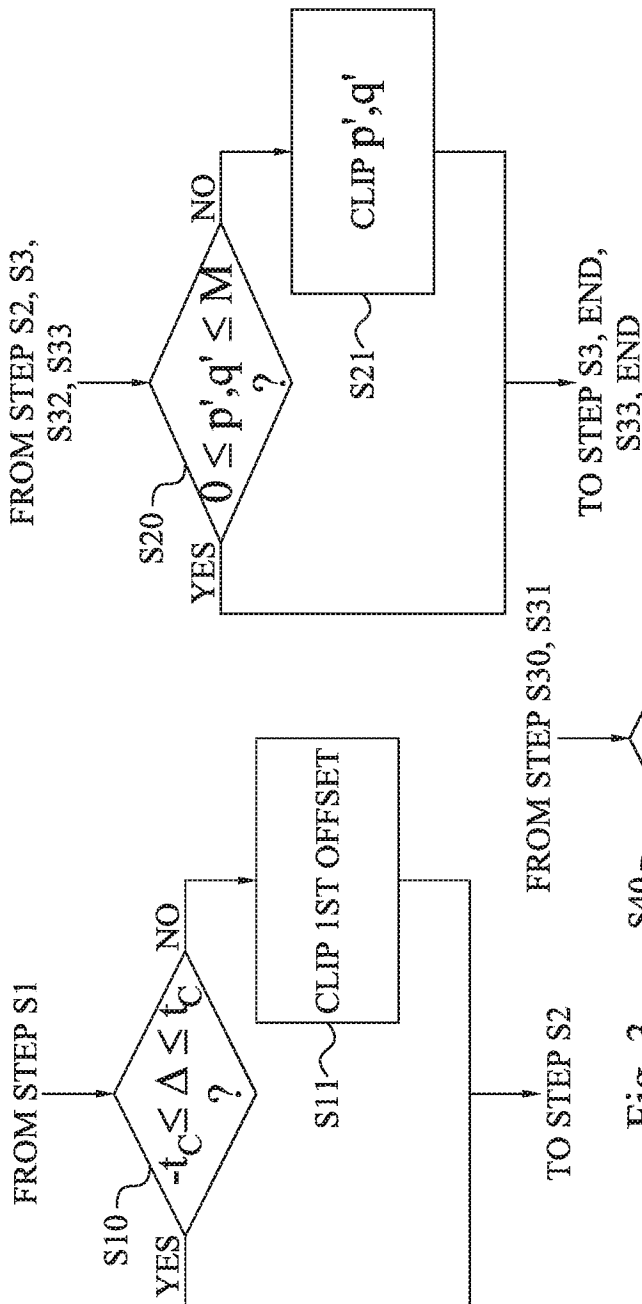


Fig. 4

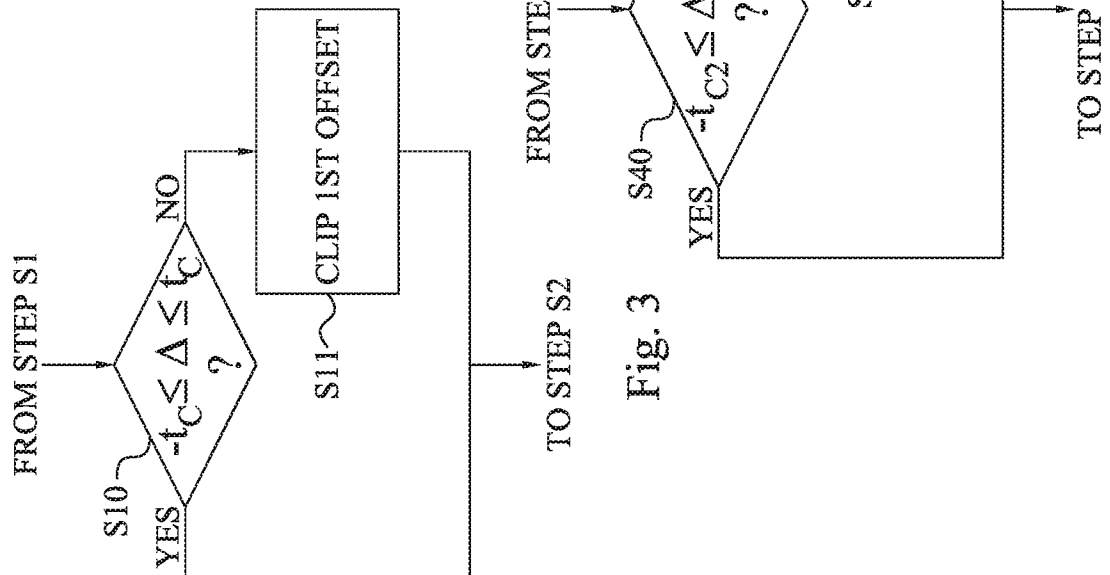


Fig. 6

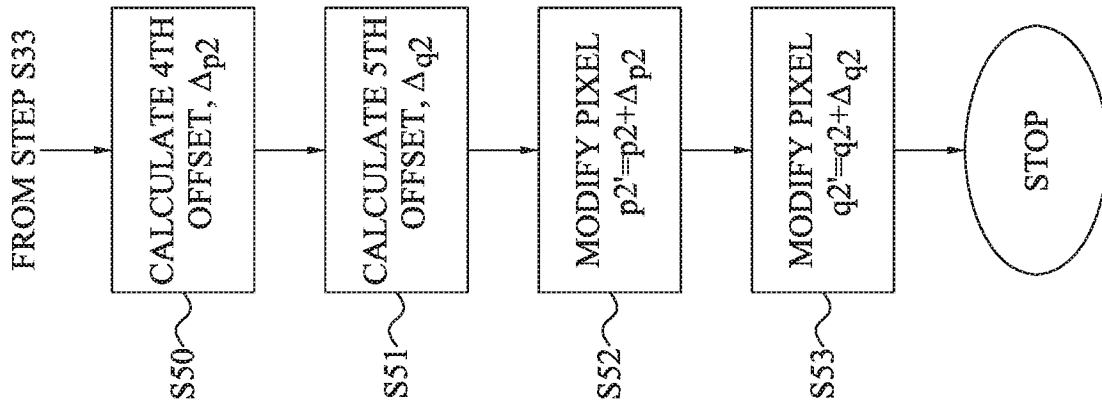


Fig. 7

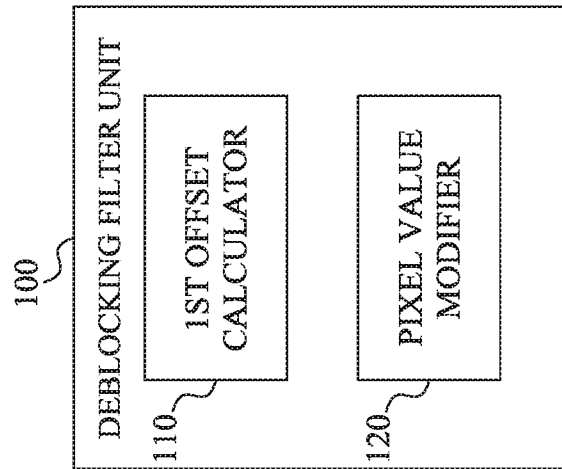


Fig. 8

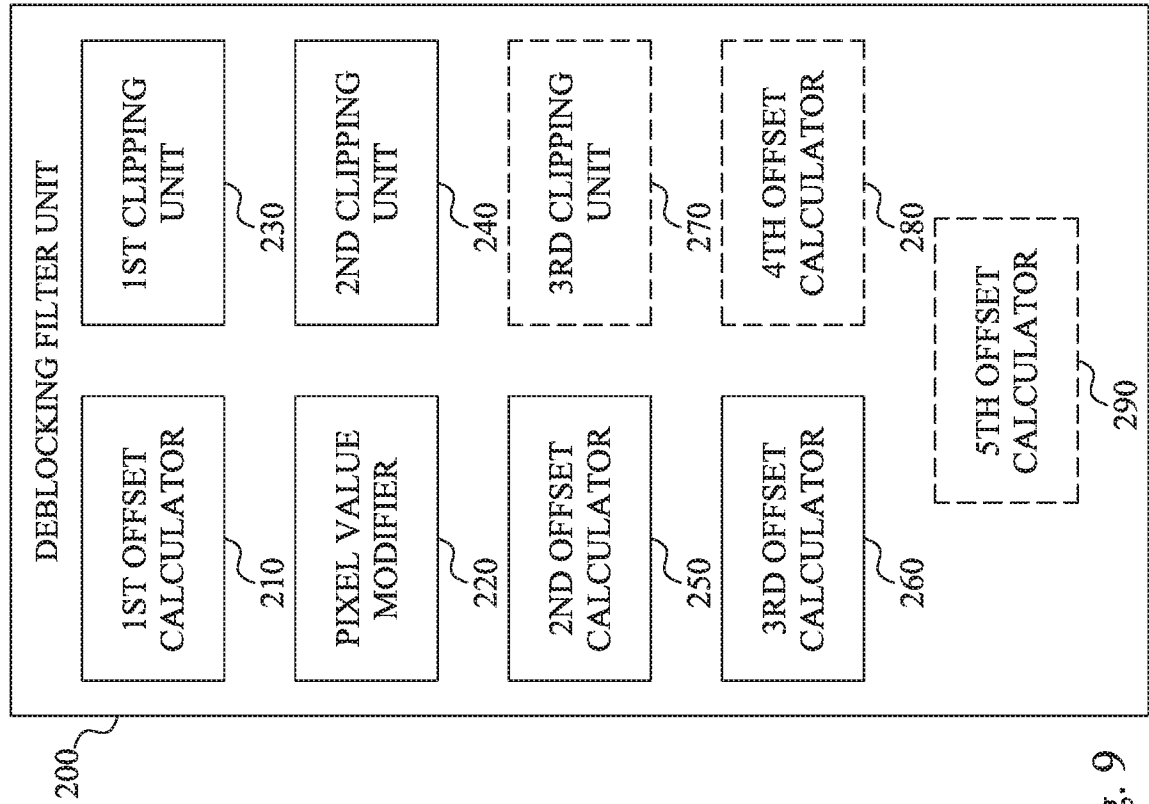


Fig. 9

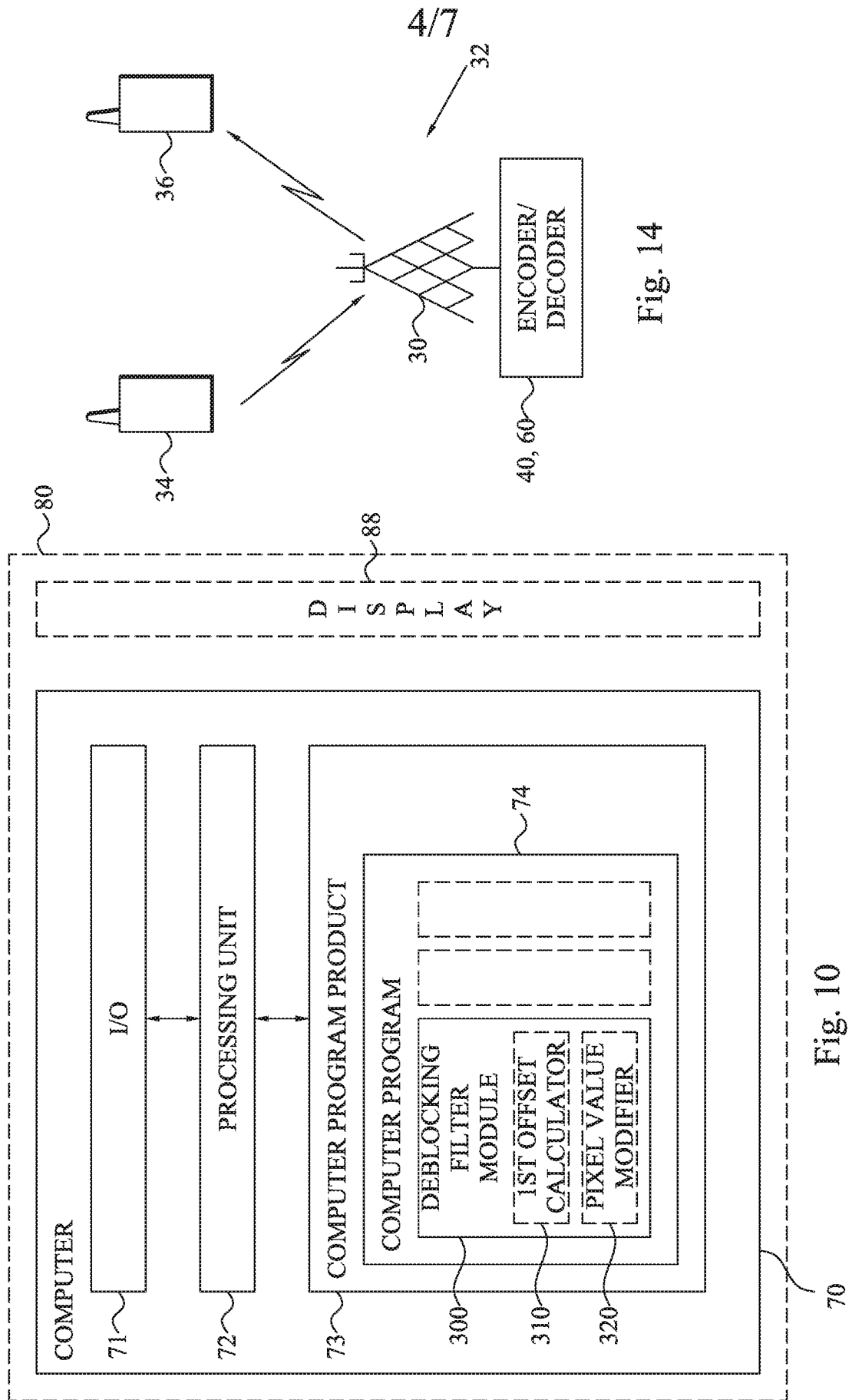


Fig. 14

Fig. 10

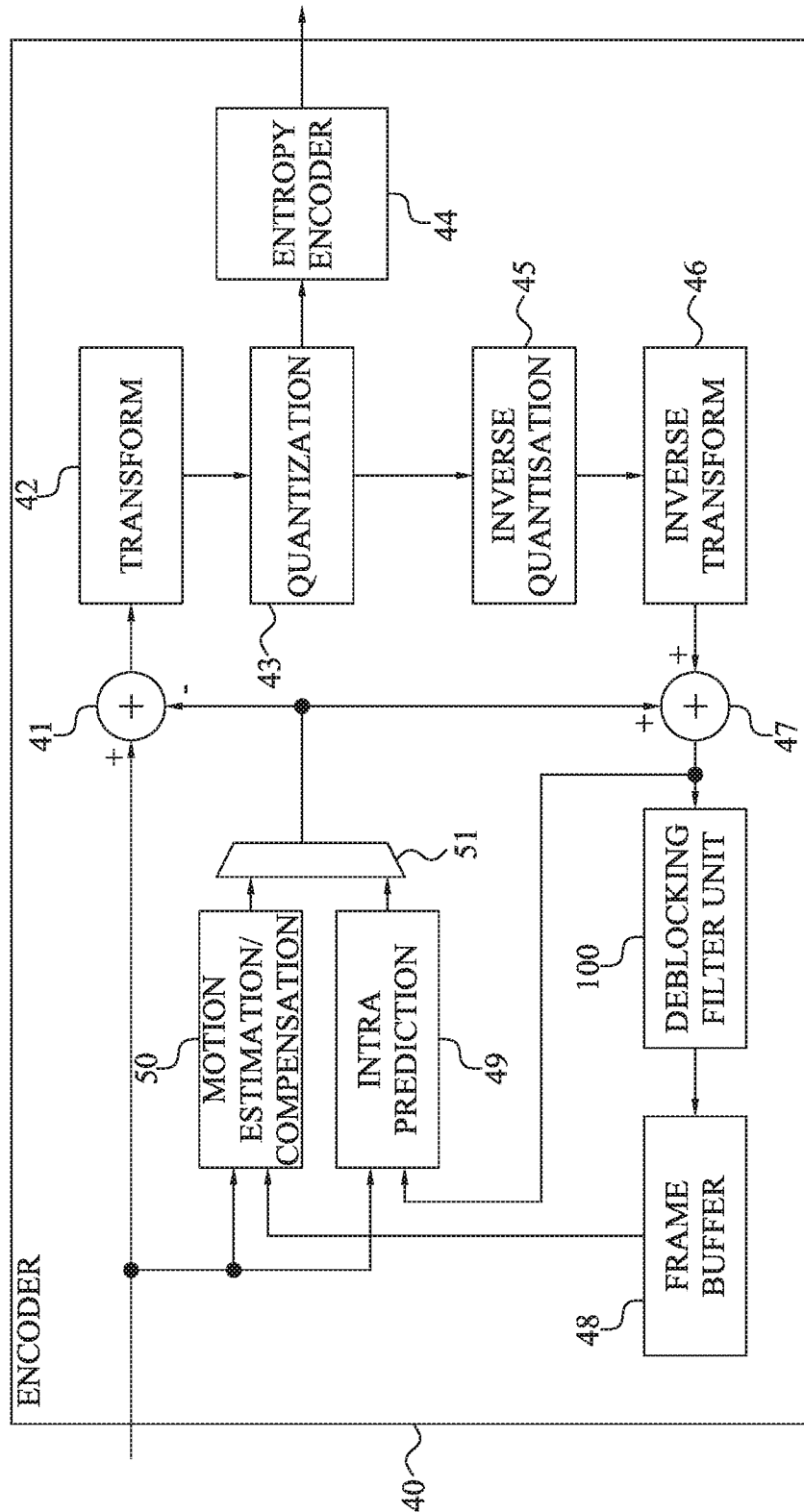


Fig. 11

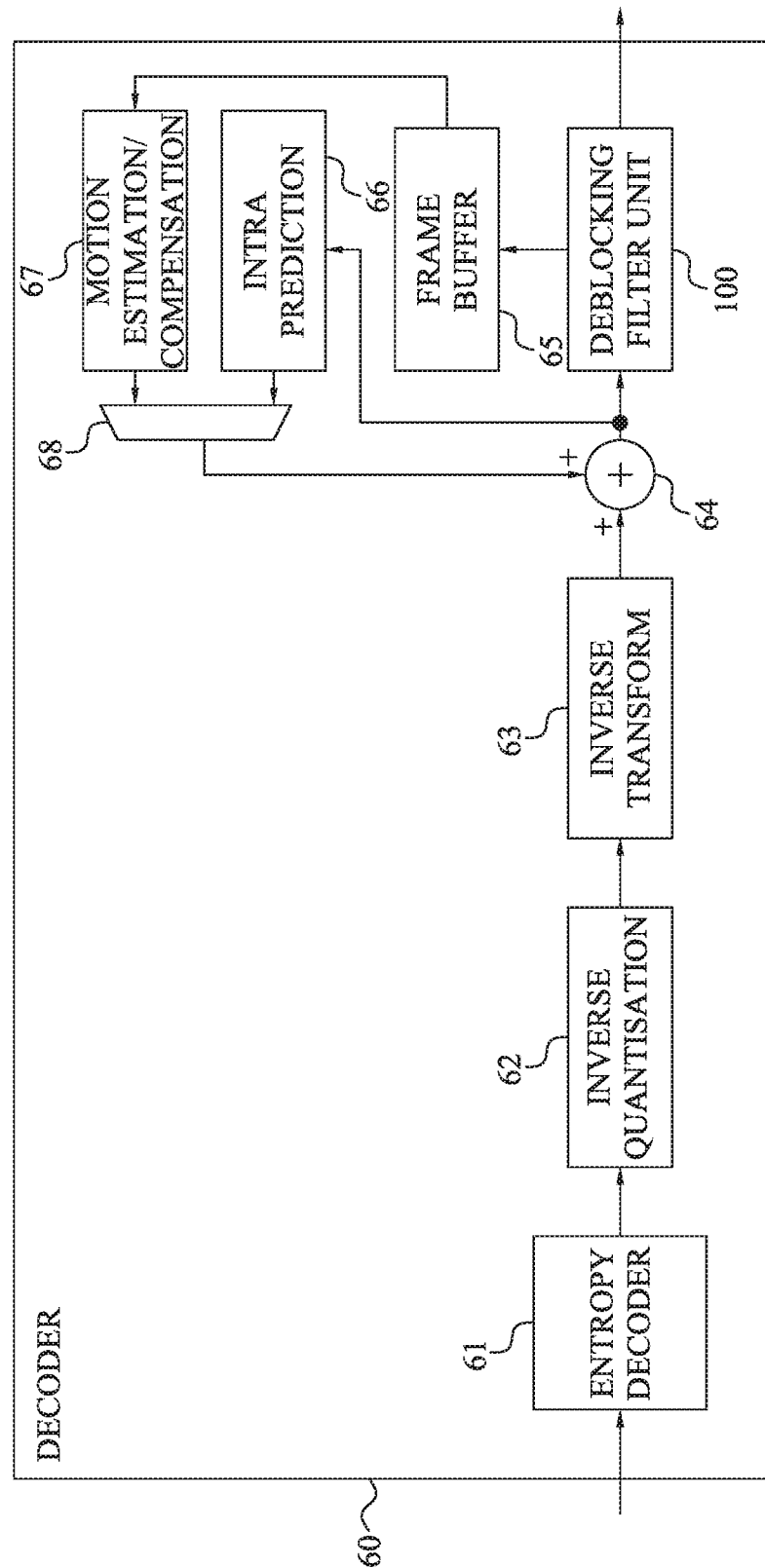


Fig. 12

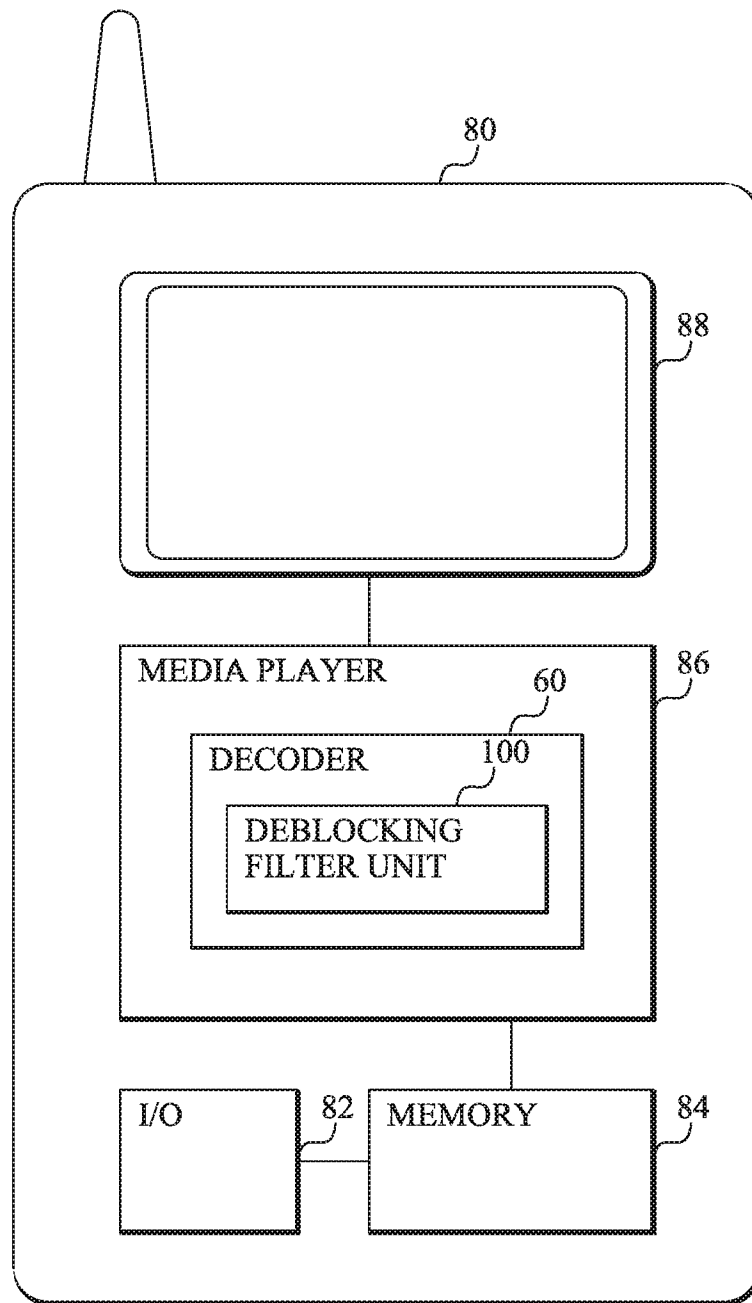


Fig. 13

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	3602-518US5
		Application Number	
Title of Invention	DEBLOCKING FILTERING		
The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76. This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.			

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1					Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Andrey		NORKIN		
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service					
City	Solna	Country of Residence ⁱ	SE		
Mailing Address of Inventor:					
Address 1		Blomgatan 6			
Address 2					
City	Solna	State/Province			
Postal Code	169 60	Country ⁱ	SE		
Inventor 2					Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Kenneth		ANDERSSON		
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service					
City	Gavle	Country of Residence ⁱ	SE		
Mailing Address of Inventor:					
Address 1		Vastra Tradgardsvagen 52			
Address 2					
City	Gavle	State/Province			
Postal Code	802 63	Country ⁱ	SE		
Inventor 3					Remove
Legal Name					

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	3602-518US5
		Application Number	
Title of Invention	DEBLOCKING FILTERING		

Prefix	Given Name	Middle Name	Family Name	Suffix
	Rickard		SJÖBERG	
Residence Information (Select One) ☐ US Residency ☒ Non US Residency ☐ Active US Military Service				
City	Stockholm	Country of Residence ⁱ	SE	

Mailing Address of Inventor:

Address 1	Robert Almströmsgatan 9A			
Address 2				
City	Stockholm	State/Province		
Postal Code	113 36	Country ⁱ	SE	

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button.

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ An Address is being provided for the correspondence information of this application.

Customer Number	06449		
Email Address	pto-pat-email@rfem.com	Add Email	Remove Email

Application Information:

Title of the Invention	DEBLOCKING FILTERING		
Attorney Docket Number	3602-518US5	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	7	Suggested Figure for Publication (if any)	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	3602-518US5
		Application Number	
Title of Invention	DEBLOCKING FILTERING		

Publication Information:

☐	Request Early Publication (Fee required at time of Request 37 CFR 1.219)
☐	Request Not to Publish. I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application has not and will not be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32). Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.			
Please Select One:	☒ Customer Number	☐ US Patent Practitioner	☐ Limited Recognition (37 CFR 11.9)
Customer Number	06449		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove		
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
	Continuation of	15/008013	2016-01-27		
Prior Application Status	Patented		Remove		
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15/008013	Continuation of	13/955448	2013-07-31	9407912	2016-08-02
Prior Application Status	Patented		Remove		
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13/955448	Continuation of	13/583437	2012-09-07	8526509	2013-09-03
Prior Application Status	Expired		Remove		
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
13/583437	a 371 of international	PCT/SE2011/051199	2011-10-06		

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	3602-518US5
		Application Number	
Title of Invention	DEBLOCKING FILTERING		
Prior Application Status	Expired	Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
PCT/SE2011/051199	Claims benefit of provisional	61/432751	2011-01-14
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.			

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)ⁱ the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

			Remove
Application Number	Country ⁱ	Filing Date (YYYY-MM-DD)	Access Code ^j (if applicable)
Additional Foreign Priority Data may be generated within this form by selecting the Add button.			

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.

NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	3602-518US5
		Application Number	
Title of Invention	DEBLOCKING FILTERING		

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	3602-518US5
		Application Number	
Title of Invention	DEBLOCKING FILTERING		

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.			
Applicant 1			
If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.			
Clear			
☒ Assignee		☐ Legal Representative under 35 U.S.C. 117	
☐ Person to whom the inventor is obligated to assign.		☐ Person who shows sufficient proprietary interest	
If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:			
Name of the Deceased or Legally Incapacitated Inventor:			
If the Applicant is an Organization check here. ☒			
Organization Name	Telefonaktiebolaget L M Ericsson (publ)		
Mailing Address Information For Applicant:			
Address 1			
Address 2			
City	Stockholm	State/Province	
Country	SE	Postal Code	SE-164 83
Phone Number		Fax Number	
Email Address			
Additional Applicant Data may be generated within this form by selecting the Add button.			

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	3602-518US5
		Application Number	
Title of Invention	DEBLOCKING FILTERING		

Assignee 1			
Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.			
If the Assignee or Non-Applicant Assignee is an Organization check here. ☒			
Organization Name	Telefonaktiebolaget L M Ericsson (publ)		
Mailing Address Information For Assignee including Non-Applicant Assignee:			
Address 1			
Address 2			
City	Stockholm	State/Province	
Country i	SE	Postal Code	SE-164 83
Phone Number		Fax Number	
Email Address			
Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.			

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). However, if this Application Data Sheet is submitted with the <u>INITIAL</u> filing of the application and either box A or B is <u>not</u> checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).			
This Application Data Sheet must be signed by a patent practitioner if one or more of the applicants is a juristic entity (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, all joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of all joint inventor-applicants.			
See 37 CFR 1.4(d) for the manner of making signatures and certifications.			
Signature	/Brian S. Rosenbloom/		Date (YYYY-MM-DD)
First Name	Brian S.	Last Name	Rosenbloom
Registration Number	41276		
Additional Signature may be generated within this form by selecting the Add button.			

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	3602-518US5
		Application Number	
Title of Invention	DEBLOCKING FILTERING		

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:

Filing Date:

Title of Invention:

DEBLOCKING FILTERING

First Named Inventor/Applicant Name:

Andrey NORKIN

Filer:

Brian S. Rosenbloom/Sheda Vasseghi

Attorney Docket Number:

3602-518US5

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	280	280
UTILITY SEARCH FEE	1111	1	600	600
UTILITY EXAMINATION FEE	1311	1	720	720

Pages:

Claims:

Miscellaneous-Filing:

Petition:

Patent-Appeals-and-Interference:

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				1600

Electronic Acknowledgement Receipt

EFS ID:	29660941
Application Number:	15639229
International Application Number:	
Confirmation Number:	2772
Title of Invention:	DEBLOCKING FILTERING
First Named Inventor/Applicant Name:	Andrey NORKIN
Customer Number:	6449
Filer:	Brian S. Rosenbloom/Sheda Vasseghi
Filer Authorized By:	Brian S. Rosenbloom
Attorney Docket Number:	3602-518US5
Receipt Date:	30-JUN-2017
Filing Date:	
Time Stamp:	14:55:11
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	\$ 1600
RAM confirmation Number	070317INTEFSW14562000
Deposit Account	022135
Authorized User	Sheda Vasseghi

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)
37 CFR 1.20 (Post Issuance fees)
37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		518US5_IDS.pdf	302126	yes	7
			e2d81cc6f70582b1001e1517c8750952ff91ae53		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Transmittal Letter		1	1	
	Information Disclosure Statement (IDS) Form (SB08)		2	7	
Warnings:					
Information:					
2		518US5_POA.pdf	98790	yes	3
			e668961b96d4c9989c232faa42cfa91592806882		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Power of Attorney		1	1	
	Assignee showing of ownership per 37 CFR 3.73		2	3	
Warnings:					
Information:					
3	Oath or Declaration filed	518US5_DECL.pdf	97444	no	3
			2de45621a7653ec8c1053a6b89a4aacf59b3e0e6		
Warnings:					
Information:					
4		518US5_SPEC_new.pdf	252956	yes	49
			f341b3d97eb247b19edb93e88dafd3ff53b12ae8		

	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Specification		1	40	
	Claims		41	48	
	Abstract		49	49	
Warnings:					
Information:					
5	Drawings-only black and white line drawings	518US5_dwgs_new.PDF	533933	no	7
			133464b16aa71707ae14071b857d9d7211212bc9		
Warnings:					
Information:					
6	Application Data Sheet	518US5_ADS.pdf	461007	no	9
			093180b5bb6e5335b14caffbe6287f84751ec370		
Warnings:					
Information:					
This is not an USPTO supplied ADS fillable form					
7	Fee Worksheet (SB06)	fee-info.pdf	35003	no	2
			ae27d9a796434cbadeb81ff61bea062c0657ecd8		
Warnings:					
Information:					
Total Files Size (in bytes):			1781259		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No. : Continuation of 15/008,013
First Named Inventor : Andrey NORKIN
Filed : Herewith
TC/A.U. :
Examiner :

Docket No. : 3602-518US5
Customer No. : 06449
Confirmation No. :

INFORMATION DISCLOSURE STATEMENT

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

Dear Sir:

Under the provisions of 37 C.F.R. §§ 1.56, 1.97 and 1.98, Applicants submit herewith Form SB/08 listing publications that the Office may wish to consider in examination of the subject application.

Pursuant to 1.98(d), copies of the references are not included because they were previously submitted to the Office in an application to which priority is or has been claimed under 35 USC § 120.

Respectfully submitted,

By  _____
Brian S. Rosenbloom
Attorney for Applicants
Registration No. 41,276
ROTHWELL, FIGG, ERNST & MANBECK, p.c.
Suite 800, 607 14th Street, N.W.
Washington, D.C. 20005
Telephone: (202)783-6040
Email: brosenbloom@rfem.com

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875						Application or Docket Number 15/639,229				
APPLICATION AS FILED - PART I										
(Column 1)		(Column 2)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY				
FOR	NUMBER FILED	NUMBER EXTRA	RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)			
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	280			
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A			N/A	600			
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	720			
TOTAL CLAIMS (37 CFR 1.16(j))	18	minus 20 = *				x 80 =	0.00			
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2	minus 3 = *				x 420 =	0.00			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL		TOTAL	1600			
APPLICATION AS AMENDED - PART II										
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY		
AMENDMENT A		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=		x	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=		x	=
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))									
						TOTAL ADD'L FEE			TOTAL ADD'L FEE	
AMENDMENT B		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=		x	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=		x	=
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))									
						TOTAL ADD'L FEE			TOTAL ADD'L FEE	
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3. ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20". *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3". The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.										



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
15/639,229	06/30/2017	2668	1600	3602-518US5	18	2

CONFIRMATION NO. 2772

FILING RECEIPT

6449

ROTHWELL, FIGG, ERNST & MANBECK, P.C.
607 14th Street, N.W.
SUITE 800
WASHINGTON, DC 20005



Date Mailed: 07/11/2017

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Andrey NORKIN, Solna, SWEDEN;
Kenneth ANDERSSON, Gavle, SWEDEN;
Rickard SJÖBERG, Stockholm, SWEDEN;

Applicant(s)

Telefonaktiebolaget L M Ericsson (publ), Stockholm, SWEDEN;

Assignment For Published Patent Application

Telefonaktiebolaget L M Ericsson (publ), Stockholm, SWEDEN

Power of Attorney: The patent practitioners associated with Customer Number 06449

Domestic Priority data as claimed by applicant

This application is a CON of 15/008,013 01/27/2016
which is a CON of 13/955,448 07/31/2013 PAT 9407912
which is a CON of 13/583,437 09/07/2012 PAT 8526509
which is a 371 of PCT/SE2011/051199 10/06/2011
which claims benefit of 61/432,751 01/14/2011

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see <http://www.uspto.gov> for more information.) - None.

Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 07/10/2017

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/639,229**

Projected Publication Date: 10/19/2017

Non-Publication Request: No

Early Publication Request: No
Title

DEBLOCKING FILTERING

Preliminary Class

382

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at <http://www.uspto.gov/web/offices/pac/doc/general/index.html>.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, <http://www.stopfakes.gov>. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific

countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER
Title 35, United States Code, Section 184
Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign Assets Control, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop

technology, manufacture products, deliver services, and grow your business, visit <http://www.SelectUSA.gov> or call +1-202-482-6800.



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/639,229	06/30/2017	Andrey NORKIN	3602-518US5

CONFIRMATION NO. 2772

PUBLICATION NOTICE



OC00000094866887

6449
ROTHWELL, FIGG, ERNST & MANBECK, P.C.
607 14th Street, N.W.
SUITE 800
WASHINGTON, DC 20005

Title:DEBLOCKING FILTERING

Publication No.US-2017-0302967-A1

Publication Date:10/19/2017

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently <http://www.uspto.gov/patft/>.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently <https://portal.uspto.gov/pair/PublicPair>. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/639,229	06/30/2017	Andrey NORKIN	3602-518US5	2772

6449 7590 01/26/2018
ROTHWELL, FIGG, ERNST & MANBECK, P.C.
607 14th Street, N.W.
SUITE 800
WASHINGTON, DC 20005

EXAMINER

TORRENTE, RICHARD T

ART UNIT	PAPER NUMBER
----------	--------------

2485

NOTIFICATION DATE	DELIVERY MODE
-------------------	---------------

01/26/2018

ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

PTO-PAT-Email@rfem.com

Office Action Summary	Application No. 15/639,229	Applicant(s) NORKIN ET AL.	
	Examiner RICHARD TORRENTE	Art Unit 2485	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 6/30/17.
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
- 4) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

- 5) ☒ Claim(s) 1-18 is/are pending in the application.
5a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 6) ☐ Claim(s) _____ is/are allowed.
- 7) ☒ Claim(s) 1-18 is/are rejected.
- 8) ☐ Claim(s) _____ is/are objected to.
- 9) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

- 10) ☐ The specification is objected to by the Examiner.
- 11) ☒ The drawing(s) filed on 6/30/17 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

- a) ☐ All b) ☐ Some** c) ☐ None of the:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) ☐ Notice of References Cited (PTO-892) | 3) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b)
Paper No(s)/Mail Date _____ | 4) ☐ Other: _____ |

DETAILED ACTION

1. The present application is being examined under the pre-AIA first to invent provisions.

Double Patenting

1. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the “right to exclude” granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to

Art Unit: 2485

be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

2. Claims 1-18 are rejected on the ground of nonstatutory double patenting over claims 1-23 of U. S. Patent No. 8,526,509 since the claims, if allowed, would improperly extend the "right to exclude" already granted in the patent. Although the conflicting claims are not identical, they are not patentably distinct from each other because claims 1-18 of the present application encompass claims 1-23 of U.S. Patent No. 8,526,509.

Claim Rejections - 35 USC § 101

1. 35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

The USPTO interim guidelines for Examination of Patent Applications for Patent Subject Matter Eligibility" (Official Gazette notice of 22 November 2005), Annex IV.C, reads as follows:

While abstract ideas, natural phenomena, and laws of nature are not eligible for patenting, methods and products employing abstract ideas, natural phenomena, and laws of nature to perform a real-world function may well be. In evaluating whether a claim meets the requirements of section 101, the claim must be considered as a whole to determine whether it is for a particular application or an abstract idea, natural phenomenon, or law of nature, rather than for the abstract idea, natural phenomenon, or law of nature itself.

For claims including such excluded subject matter to be eligible, the claim must be for a practical application of the abstract idea, law of nature, or natural phenomenon. Diehr, 450 U.S. at 187, 209 USPQ at 8 ("application of a law of nature of a mathematical formula to a known structure or process

Art Unit: 2485

may well be deserving of patent protection.”); Benson, 409 U.S. at 71, 175 USPQ at 676 (rejecting formula claim because it “has no substantial practical application”).

To satisfy section 101 requirement, the claim must be for a practical application of the Sec. 101 judicial exception, which can be identified in various ways:

The claimed invention “transforms” an article or physical object to a different state of thing.

The claimed invention otherwise produces a useful, concrete and tangible result, based on the factors discussed below.

Claim(s) 1-18 is/are rejected under 35 U.S.C. 101 because the claimed invention is directed to non-statutory subject matter. Claim 1 and 10 recites the mere manipulation of data or an abstract idea, or merely solves a mathematical problem without a limitation to a practical application. A practical application exists if the result of the claimed invention is “useful,, concrete and tangible” (with the emphasis in “result”) (Guidelines, section IV.C.2.b). A "useful" result is one that satisfies the utility requirement of section 101, a "concrete" result is one that is "repeatable" or “predictable”, and a “tangible” result is one that is “real”, or “real-world” as opposed to “abstract” (Guidelines, section IV.C.2.b)). Claim 1 and 10 merely manipulates data without ever producing a useful, concrete and tangible result.

In order for the claimed product to produce a "useful, concrete and tangible" results, recitation of one or more of the following elements is suggested:

- The manipulation of data that represents a physical object or activity transformed from outside the computer.
- A physical transformations outside the computer, for example in the form of pre or post computer processing activity.
- A direct recitation of a practical application;

Applicant is also advised to provide a written explanation of how and why the claimed invention (either as currently recited or as amended) produces a useful, concrete and tangible result.

Allowable Subject Matter

1. Claim(s) 1-18 is/are allowed upon overcoming the above rejection.
2. The following is an Examiner's statement of reasons for allowance: Claim(s) 1 and 10 discloses a method of reducing blocking artifacts at a block boundary between a block of multiple pixels and a neighboring block of multiple pixels in a video frame, said method comprises: calculating a first offset to be equal to $\underline{(9 \cdot (q_0 - p_0) - 3 \cdot (q_1 - p_1) + 8) \gg 4}$, wherein $\gg$ denotes a right shift operation, p_0 denotes a pixel value of a pixel closest to said block boundary in a line of pixels in said block, wherein said line of pixels is perpendicular to said block boundary, p_1 denotes a pixel value of a pixel next closest to said block boundary in said line of pixels, q_0 denotes a pixel value of a pixel closest to said block boundary in a corresponding line of pixels in said neighboring block, wherein said corresponding line of pixels is perpendicular to said block boundary and q_1 denotes a pixel value of a pixel next closest to said block boundary in said corresponding line of pixels; modifying said pixel value p_0 of said pixel closest to said block boundary in said line of pixels by adding said first offset to said pixel value p_0 of said pixel closest to said block boundary in said line of pixels to form a modified pixel value p_0' of said pixel closest to said block boundary in said line of pixels; and modifying

Art Unit: 2485

said pixel value q0 of said pixel closest to said block boundary in said corresponding line of pixels by subtracting said first offset from said pixel value q0 of said pixel closest to said block boundary in said corresponding line of pixels to form a modified pixel value q0' of said pixel closest to said block boundary in said corresponding line of pixels. The closest prior arts Hsu (IDS) and Ugur (IDS) fail to anticipate or render the above underlined limitation obvious.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to RICHARD TORRENTE whose telephone number is (571)270-3702. The examiner can normally be reached on M-F: 6:45 - 3:15 EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jay Patel can be reached on (571) 272-2988. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 2485

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/RICHARD TORRENTE/
Primary Examiner, Art Unit 2485

<i>Index of Claims</i> 	Application/Control No. 15639229	Applicant(s)/Patent Under Reexamination NORKIN ET AL.
	Examiner RICHARD TORRENTE	Art Unit 2485

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant		☐ CPA		☐ T.D.		☐ R.1.47					
CLAIM		DATE									
Final	Original	01/20/2018									
	1	✓									
	2	✓									
	3	✓									
	4	✓									
	5	✓									
	6	✓									
	7	✓									
	8	✓									
	9	✓									
	10	✓									
	11	✓									
	12	✓									
	13	✓									
	14	✓									
	15	✓									
	16	✓									
	17	✓									
	18	✓									

Search Notes 	Application/Control No. 15639229	Applicant(s)/Patent Under Reexamination NORKIN ET AL.
	Examiner RICHARD TORRENTE	Art Unit 2485

CPC- SEARCHED		
Symbol	Date	Examiner

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

SEARCH NOTES		
Search Notes	Date	Examiner
Searched EAST	1/20/18	RT
Searched CPC	1/20/18	RT
Searched inventors	1/20/18	RT

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner

--	--

Doc code: IDS

Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)

Approved for use through 07/31/2012. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		
	Filing Date		
	First Named Inventor	Andrey NORKIN	
	Art Unit		
	Examiner Name		
	Attorney Docket Number	3602-518US5	

U.S.PATENTS						
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	6167164		2006-12-26	Lee	
If you wish to add additional U.S. Patent citation information please click the Add button.						
U.S.PATENT APPLICATION PUBLICATIONS						
Examiner Initial*	Cite No	Publication Number	Kind Code ¹	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	20080117980	A1	2008-05-22	Hung Ching-Yu et al	
	2	20080123750	A1	2008-05-20	Bronstein et al	
	3	20040101059	A1	2004-05-27	Joch et al.	
	4	20060078048	A1	2006-04-13	Bjontegaard	
	5	20050147319	A1	2005-07-07	Deshpande et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number			
	Filing Date			
	First Named Inventor	Andrey NORKIN		
	Art Unit			
	Examiner Name			
	Attorney Docket Number	3602-518US5		

	6	20110194614	A1	2011-08-11	Norkin et al.	
--	---	-------------	----	------------	---------------	--

If you wish to add additional U.S. Published Application citation information please click the Add button.

FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number ³	Country Code ² i	Kind Code ⁴	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear	T ⁵
	1	02096117	WO	A1	2002-11-28	Pace Soft Silicon Ltd et al		☐
	2	2010080645	WO	A2	2010-07-15	Maxim Integrated Products		☐
	3	2011096869	WO	A1	2011-08-11	Ericsson Telefon AB LM et al		☐
	4	2005117447	WO	A2	2005-12-08	Qualcomm Incorporated		☐
	5	2011080645	WO	A1	2011-07-07	Telefonaktiebolaget LM Ericsson (publ)		☐
	6	101951519	CN	A	2011-01-19	Xidian University		☐

If you wish to add additional Foreign Patent Document citation information please click the Add button

NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T ⁵
--------------------	---------	---	----------------

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number		
Filing Date		
First Named Inventor	Andrey NORKIN	
Art Unit		
Examiner Name		
Attorney Docket Number	3602-518US5	

1	Chun-Lung Hsu; Yu-Sheng Huang, "A Fast-Deblocking Boundary-strength Based Architecture Design of Deblocking Filter in H.264/AVC Applications", Journal of Signal Processing Systems ; for Signal, Image, and Video Technology (formerly the Journal of VLSI Signal Processing Systems for Signal, Image, and Video Technology), 2007-11-20, Springer US, Boston, ISSN 1939-8115; whole document	☐
2	Ugur, K et al, "High Performance, Low Complexity Video Coding and the Emerging HEVC Standard", In: IEEE Transactions on Circuits and Systems for Video Technology, Volume: 20 Issue:12, On pages: 1688 - 1697, ISSN: 1051-8215, Digital Object Identifier: 10.1109/TCSVT.2010.2092613, Date of Publication: 18 November 2010; whole document	☐
3	Muhammad Nadeem et al, "A high-throughput, area-efficient hardware accelerator for adaptive deblocking filter in H.264/AVC", In: IEEE/ACM/IFIP 7th Workshop on Embedded Systems for Real-Time Multimedia, ISBN 978-1-4244-5169-2, ISBN 1-4244-5169-8, pages 18-27; whole document Missing date	☐
4	NORKIN, A., et al., "Development of HEVC deblocking filter", 4th JCT-VC MEETING, 95, MPEG MEETING; 20-28 January 2011; DAEGU; (JOINT COLLABORATIVE TEAM ON VIDEO CODING OF ISO/IEC JTC1/SC29/WG11 AND ITU-T SG.16); URL:HTTP://WFTP3.ITU.INT/AV-ARCH/JCTVC-SITE/, No. JCTVC-D377, January 16, 2011, 4 pages, XP030008416	☐
5	ANONYMOUS; "Test Model under Consideration", 2nd JCT-VC MEETING; 21-28 July 2010; GENEVA; (JOINT COLLABORATIVE TEAM ON VIDEO CODING OF ISO/IEC JTC1/SC29/WG11 AND ITU-T SG. 16); URL:HTTP://WFTP3.ITU.INT/AV-ARCH/JCTVC-SITE/, No. JCTVC-B205, July 28, 2010, pp. 1-152, XP030007704	☐
6	Supplementary European Search Report issued on November 8, 2013, in corresponding European application No. EP 11 85 5586, 10 pages	☐
7	Office Action issued in corresponding Japanese Application No. JP 2013-549384, on December 20, 2013, 2 pages	☐
8	Office Action (English translation only) issued on June 25, 2015 in corresponding Taiwan application No. 101101515, 3 pages	☐
9	Office Action (English translation only) issued on August 24, 2015 in corresponding Korean Application No. 10-2013-7020997, 6 pages	☐
10	First Office Action issued in related Chinese Patent Application No. 201180064761.8, dated February 3, 2016, 6 pages	☐
11	Office Action (English translation only) issued on July 31, 2015 in corresponding Japanese application No. 2014-094843, 2 pages	☐

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		
	Filing Date		
	First Named Inventor	Andrey NORKIN	
	Art Unit		
	Examiner Name		
	Attorney Docket Number	3602-518US5	

If you wish to add additional non-patent literature document citation information please click the Add button

EXAMINER SIGNATURE

Examiner Signature	/RICHARD T TORRENTE/	Date Considered	01/20/2018
--------------------	----------------------	-----------------	------------

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

¹ See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. ² Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). ³ For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. ⁴ Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. ⁵ Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		
	Filing Date		
	First Named Inventor	Andrey NORKIN	
	Art Unit		
	Examiner Name		
	Attorney Docket Number	3602-518US5	

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

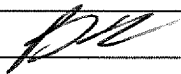
☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature		Date (YYYY-MM-DD)	2017-06-30
Name/Print	Brian Rosenbloom	Registration Number	41,276

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. **DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Application No. : 15/639,229
First Named Inventor : Andrey NORKIN
Filed : 06/30/2017

Art Unit : 2485
Examiner : Richard T. TORRENTE

Docket : 3602-518US5
Customer No. : 6449
Confirmation No. : 2772

Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

REPLY TO NON-FINAL OFFICE ACTION

This Reply is in response to the Non-Final Office Action having a notification date of January 26, 2018.

Amendments to the Specification begin on page 2 of this paper.

Amendments to the Claims begin on page 6 of this paper.

Remarks begin on page 15 of this paper.

Amendments to the Specification

Please replace paragraph [007] with the following amended paragraph:

[007] The filter decision is based on comparing three pixel differences with three thresholds. The thresholds are adapted to the quantization parameter (QP). For instance, assume a vertical block boundary of a b c d | e f g h where a, [[b c]]b, c and d denote the pixel values of the pixels of a row of pixels in the current block with e, f, g and h denoting the corresponding pixel values of the pixels of a corresponding row of pixels in the neighboring block. If the following conditions are fulfilled the filter decision is positive, e.g. $\text{abs}(d-e) < \text{thr1}$, $\text{abs}(c-d) < \text{thr2}$, and $\text{abs}(e-f) < \text{thr2}$, where thr1 and thr2 are adapted based on QP.

Please replace paragraph [0012] with the following amended paragraph:

[0012] Deblocking in HEVC ~~draft~~Draft

Please replace paragraph [0015] with the following amended paragraph:

[0015] Weak ~~filtering~~Filtering in HEVC ~~draft~~Draft

Please replace paragraph [0016] with the following amended paragraph:

[0016] Weak filtering is performed based on the above conditions. The actual filtering works by computing an offset (Δ), adding it to the original pixel value and clip the sum to a filtered output pixel value in the range of 0-255:

$$\Delta = \text{Clip}(-t_c, t_c, (13 \times (q0_i - p0_i) + 4 \times (q1_i - p1_i) - 5 \times (q2_i - p2_i) + 16) \gg 5))$$
$$\Delta = \text{Clip}(-t_c, t_c, (13 \times (q0_i - p0_i) + 4 \times (q1_i - p1_i) - 5 \times (q2_i - p2_i) + 16) \gg 5)$$

$$\begin{aligned}p0_i &= \text{Clip}_{0-255}(p0_i + \Delta) \\q0_i &= \text{Clip}_{0-255}(q0_i - \Delta) \\p1_i &= \text{Clip}_{0-255}(p1_i + \Delta/2) \\q1_i &= \text{Clip}_{0-255}(q1_i - \Delta/2)\end{aligned}$$

Please replace paragraph [0017] with the following amended paragraph:

[0017] Strong ~~filtering~~Filtering in HEVC ~~draft~~Draft

Please replace paragraph [0073] with the following amended paragraph:

[0073] The line 12 of pixels 11, 13, 15, 17 in the block 10 and the corresponding line 22 of pixels 21, 23, 25, 27 in the neighboring block 20 belong to the same horizontal line of pixels, i.e. row of pixels, extending over a vertical boundary 1, see Fig. 2A, or belong to the same vertical line of pixels, i.e. column of pixels, extending over a horizontal boundary 1, see Fig. 2B. Hence, the line 12 of pixels 11, 13, 15, 17 and the corresponding line 22 of pixels 21, 23, 25, 27 are perpendicular to the block boundary 1 between the block 10 and the neighboring block 20. Furthermore, the line 12 of pixels 11, 13, 15, 17 in the block 10 and the corresponding line 22 of pixels 21, 23, 25, 27 in the neighboring block 20 have the same line number. For instance, if the block 10 and the neighboring block 20 each comprises N , such as eight, rows or columns of pixels, having row or column numbers $i=0\dots N-1$ then the line [[10]]12 of pixels 11, 13, 15, 17 has line number i in the block 10 and the corresponding line [[20]]22 of pixels 21, 23, 25, 27 also has line number i but in the neighboring block 20. Thus, line 12 of pixels 11, 13, 15, 17 in the block and the corresponding line 22 of pixels 21, 23, 25, 27 in the neighboring block 20 are opposing lines with regard to the block boundary 1.

Please replace paragraph [0077] with the following amended paragraph:

[0077] The method illustrated in Fig. 1 and including steps S1 to S3 reduces blocking artifacts at the block boundary 1 by processing pixels in one line [[11]]12 of pixels 11, 13, 15, 17 in the block and also in the corresponding line 22 of pixels 21, 23, 25, 27 in the neighboring block 20. This pixel modification can be performed for one of the (horizontal or vertical) lines 12 in the block 10 or for multiple, i.e. at least two, lines 12 in the block 10, possibly for all (horizontal or vertical) lines 12 in the block 10. This is schematically illustrated by the line L1.

Please replace paragraph [00102] with the following amended paragraph:

[00102] An alternative embodiment for calculating the second and third offsets, which is adapted for hardware-implementation, is:

$$\Delta_p = \text{Clip3}(-t_{c2}, t_{c2}, ((p2 + p0 - ((p1 - \Delta) << 1) + 2) >> 2))$$

$$\Delta_q = \text{Clip3}(-t_{c2}, t_{c2}, ((q2 + q0 - ((q1 + \Delta) << 1) + 2) >> 2))$$

$$\Delta_q = \text{Clip3}(-t_{c2}, t_{c2}, ((q2 + q0 - ((q1 + \Delta) << 1) + 2) >> 2))$$

Please replace paragraph [00109] with the following amended paragraph:

[00109] The fourth and fifth offsets can, in an alternative embodiment, be calculated to be based on $(p3 + p1 - 2 \times p2 + \Delta_{p1})/2$ and $(q3 + q1 - 2 \times q2 + \Delta_{q1})/2$ respectively, or alternatively

$$(p3 + p1 - 2 \times p2 + 2 \times \Delta_{q1})/4 \text{ and } (q3 + q1 - 2 \times q2 + 2 \times \Delta_{p2})/4.$$

$$(p3 + p1 - 2 \times p2 + 2 \times \Delta_{q1})/4 \text{ and } (q3 + q1 - 2 \times q2 + 2 \times \Delta_{q2})/4.$$

Please replace paragraph [0015] with the following amended paragraph:

[00149] The transformed and quantized residual error for the current block of pixels is also provided to an inverse quantizer 45 and inverse transformer 46 to retrieve the original residual error. This error is added by an adder 47 to the block prediction output from the motion compensator 50 or the intra predictor 49 to create a reference block of pixels that can be used in the prediction and coding of a next block of pixels. This new reference block is first processed by a deblocking filter unit 100 according to the embodiments in order to perform deblocking filtering to combat any blocking artifact. The processed new reference block is then temporarily stored in a frame buffer 48, where it is available to the intra predictor 49 and the motion estimator/compensator 50.

Amendments to the Claims:

1. (Original) A method of reducing blocking artifacts at a block boundary between a block of multiple pixels and a neighboring block of multiple pixels in a video frame, said method comprises:

calculating a first offset to be equal to $(9 \times (q_0 - p_0) - 3 \times (q_1 - p_1) + 8) \gg 4$, wherein $\gg$ denotes a right shift operation, p_0 denotes a pixel value of a pixel closest to said block boundary in a line of pixels in said block, wherein said line of pixels is perpendicular to said block boundary, p_1 denotes a pixel value of a pixel next closest to said block boundary in said line of pixels, q_0 denotes a pixel value of a pixel closest to said block boundary in a corresponding line of pixels in said neighboring block, wherein said corresponding line of pixels is perpendicular to said block boundary and q_1 denotes a pixel value of a pixel next closest to said block boundary in said corresponding line of pixels;

modifying said pixel value p_0 of said pixel closest to said block boundary in said line of pixels by adding said first offset to said pixel value p_0 of said pixel closest to said block boundary in said line of pixels to form a modified pixel value p_0' of said pixel closest to said block boundary in said line of pixels; and

modifying said pixel value q_0 of said pixel closest to said block boundary in said corresponding line of pixels by subtracting said first offset from said pixel value q_0 of said pixel closest to said block boundary in said corresponding line of pixels to form a modified pixel value q_0' of said pixel closest to said block boundary in said corresponding line of pixels.

2. (Original) The method according to claim 1, further comprising clipping said first offset to be within an interval of $-t_c$ and t_c by setting said first offset to be equal to $-t_c$ if said first offset is smaller than $-t_c$ and by setting said first offset to be equal to t_c if said first offset is larger than t_c , wherein t_c is a threshold value that is dependent on a quantization parameter value assigned to said block.

3. (Original) The method according to claim 1, further comprising:

clipping said modified pixel value $p0'$ of said pixel closest to said block boundary in said line of pixels to be within an interval of zero and a defined maximum value by setting said modified pixel value $p0'$ of said pixel closest to said block boundary in said line of pixels to be equal to zero if said modified pixel value $p0'$ of said pixel closest to said block boundary in said line of pixels is smaller than zero and by setting said modified pixel value $p0'$ of said pixel closest to said block boundary in said line of pixels to be equal to said defined maximum value if said modified pixel value $p0'$ of said pixel closest to said block boundary in said line of pixels is larger than said defined maximum value; and

clipping said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels to be within an interval of zero and said defined maximum value by setting said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels to be equal to zero if said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels is smaller than zero and by setting said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels to be equal to said defined maximum if said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels is larger than said defined maximum value.

4. (Currently Amended) The method according to claim 1, further comprising:

calculating a second offset to be based on $(p2+p0=2 \times p1+2 \times \Delta)/4$, wherein $p2$ denotes a pixel value of a pixel second next closest to said block boundary in said line of pixels and Δ denotes said first offset;

calculating a third offset to be based on $(q2+q0-2 \times q1-2 \times \Delta)/4$, wherein $q2$ denotes a pixel value of a pixel second next closest to said block boundary in said corresponding line of pixels;

modifying said pixel value $p1$ of said pixel next closest to said block boundary in said line of pixels by adding said second offset to said pixel value $p1$ of said pixel next closest to said block boundary in said line of pixels to form a modified pixel value $p1'$ of said pixel next closest to said block boundary in said line of pixels; and

modifying said pixel value q_l of said pixel next closest to said block boundary in said corresponding line of pixels by adding said third offset to said pixel value q_l of said pixel next closest to said block boundary in said corresponding line of pixels to form a modified pixel value q_l' of said pixel next closest to said block boundary in said corresponding line of pixels.

5. (Original) The method according to claim 4, wherein
calculating said second offset comprises calculating said second offset to be equal to $((p_2 + p_0 + 1) \gg 1) - p_1 + \Delta \gg 1$, wherein $\gg$ denotes a right shift operation; and
calculating said third offset comprises calculating said third offset to be equal to $((q_2 + q_0 + 1) \gg 1) - q_l - \Delta \gg 1$.

6. (Original) The method according to claim 4, further comprising:
clipping said second offset to be within an interval of $-t_{C2}$ and t_{C2} by setting said second offset to be equal to $-t_{C2}$ if said second offset is smaller than $-t_{C2}$ and by setting said second offset to be equal to t_{C2} if said second offset is larger than t_{C2} , wherein t_{C2} is a threshold value that is dependent on a quantization parameter value assigned to said block; and
clipping said third offset within an interval of $-t_{C2}$ and t_{C2} by setting said third offset to be equal to $-t_{C2}$ if said third offset is smaller than $-t_{C2}$ and by setting said third offset to be equal to t_{C2} if said third offset is larger than t_{C2} .

7. (Original) The method according to claim 4, further comprising:
clipping said modified pixel value p_1' of said pixel next closest to said block boundary in said line of pixels to be within an interval of zero and a defined maximum value by setting said modified pixel value p_1' of said pixel next closest to said block boundary in said line of pixels to be equal to zero if said modified pixel value p_1' of said pixel next closest to said block boundary in said line of pixels is smaller than zero and by setting said modified pixel value p_1' of said pixel next closest to said block boundary in said line of pixels to be equal to said defined maximum value if said modified pixel value p_1' of said pixel next closest to said block boundary in said line of pixels is larger than said defined maximum value; and

clipping said modified pixel value $q1'$ of said pixel next closest to said block boundary in said corresponding line of pixels to be within an interval of zero and said defined maximum value by setting said modified pixel value $q1'$ of said pixel next closest to said block boundary in said corresponding line of pixels to be equal to zero if said modified pixel value $q1'$ of said pixel next closest to said block boundary in said corresponding line of pixels is smaller than zero and by setting said modified pixel value $q1'$ of said pixel next closest to said block boundary in said corresponding line of pixels to be equal to said defined maximum if said modified pixel value $q1'$ of said pixel next closest to said block boundary in said corresponding line of pixels is larger than said defined maximum value.

8. (Original) The method according to claim 4, further comprising:

calculating a fourth offset to be based on $(p3+p1-2 \times p2+2 \times \Delta_{p1})/4$, wherein $p3$ denotes a pixel value of a pixel third next closest to said block boundary in said line of pixels and Δ_{p1} denotes said second offset; and

calculating a fifth offset to be based on $(q3+q1-2 \times q2+2 \times \Delta_{q1})/4$, wherein $q3$ denotes a pixel value of a pixel third closest to said block boundary in said corresponding line of pixels and Δ_{q1} denotes said third offset;

modifying said pixel value $p2$ of said pixel second next closest to said block boundary in said line of pixels by adding said fourth offset to said pixel value $p2$ of said pixel second next closest to said block boundary in said line of pixels to form a modified pixel value $p2'$ of said pixel second next closest to said block boundary in said line of pixels; and

modifying said pixel value $q2$ of said pixel second next closest to said block boundary in said corresponding line of pixels by adding said fifth offset to said pixel value $q2$ of said pixel second next closest to said block boundary in said corresponding line of pixels to form a modified pixel value $q2'$ of said pixel second next closest to said block boundary in said corresponding line of pixels.

9. (Original) The method according to claim 8, wherein

calculating said fourth offset comprises calculating said fourth offset to be equal to $((p3+p1+1) \gg 1) - p2 + \Delta_{p1}$, wherein $\gg$ denotes a right shift operation; and

calculating said fifth offset comprises calculating said fifth offset to be equal to $((q_3 + q_1 + 1) \gg 1) - q_2 + \Delta_{q_1} \gg 1$.

10. (Original) A user equipment comprising a deblocking filter unit for reducing blocking artifacts at a block boundary between a block of multiple pixels and a neighboring block of multiple pixels in a video frame, wherein the deblocking filter unit comprises:

a first offset calculator configured to calculate a first offset to be equal to $(9 \times (q_0 - p_0) - 3 \times (q_1 - p_1) + 8) \gg 4$, wherein $\gg$ denotes a right shift operation, p_0 denotes a pixel value of a pixel closest to said block boundary in a line of pixels in said block, wherein said line of pixels is perpendicular to said block boundary, p_1 denotes a pixel value of a pixel next closest to said block boundary in said line of pixels, q_0 denotes a pixel value of a pixel closest to said block boundary in a corresponding line of pixels in said neighboring block, wherein said corresponding line of pixels is perpendicular to said block boundary, and q_1 denotes a pixel value of a pixel next closest to said block boundary in said corresponding line of pixels; and

a pixel value modifier configured to modify said pixel value p_0 of said pixel closest to said block boundary in said line of pixels by adding said first offset to said pixel value p_0 of said pixel closest to said block boundary in said line of pixels to form a modified pixel value p_0' of said pixel closest to said block boundary in said line of pixels and to modify said pixel value q_0 of said pixel closest to said block boundary in said corresponding line of pixels by subtracting said first offset from said pixel value q_0 of said pixel closest to said block boundary in said corresponding line of pixels to form a modified pixel value q_0' of said pixel closest to said block boundary in said corresponding line of pixels.

11. (Original) The user equipment according to claim 10, wherein the deblocking filter unit further comprises a first clipping unit configured to clip said first offset within an interval of $-t_c$ and t_c by setting said first offset to be equal to $-t_c$ if said first offset is smaller than $-t_c$ and by setting said first offset to be equal to t_c if said first offset is larger than t_c , wherein t_c is a threshold value that is dependent on a quantization parameter value assigned to said block.

12. (Original) The user equipment according to claim 10, wherein the deblocking filter unit further comprises a second clipping unit configured to clip said modified pixel value $p0'$ of said pixel closest to said block boundary in said line of pixels to be within an interval of zero and a defined maximum value by setting said modified pixel value $p0'$ of said pixel closest to said block boundary in said line of pixels to be equal to zero if said modified pixel value $p0'$ of said pixel closest to said block boundary in said line of pixels is smaller than zero and by setting said modified pixel value $p0'$ of said pixel closest to said block boundary in said line of pixels to be equal to said defined maximum value if said modified pixel value $p0'$ of said pixel closest to said block boundary in said line of pixels is larger than said defined maximum value and to clip said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels to be within an interval of zero and said defined maximum value by setting said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels to be equal to zero if said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels is smaller than zero and by setting said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels to be equal to said defined maximum if said modified pixel value $q0'$ of said pixel closest to said block boundary in said corresponding line of pixels is larger than said defined maximum value.

13. (Original) The user equipment according to claim 10, wherein the deblocking filter unit further comprises:

a second offset calculator configured to calculate a second offset to be based on $(p2+p0-2 \times p1+2 \times \Delta)/4$, wherein $p2$ denotes a pixel value of a pixel second next closest to said block boundary in said line of pixels and Δ denotes said first offset; and

a third offset calculator configured to calculate a third offset to be based on $(q2+q0-2 \times q1-2 \times \Delta)/4$, wherein $q2$ denotes a pixel value of a pixel second next closest to said block boundary in said corresponding line of pixels,

wherein said pixel value modifier is configured to modify said pixel value $p2$ of said pixel second next closest to said block boundary in said line of pixels by adding said second offset to said pixel value $p2$ of said pixel second next closest to said block boundary in said line of pixels to form a modified pixel value $p2'$ of said pixel second next closest to said block boundary in said

line of pixels and to modify said pixel value q_2 of said pixel second next closest to said block boundary in said corresponding line of pixels by adding said third offset to said pixel value q_2 of said pixel second next closest to said block boundary in said corresponding line of pixels to form a modified pixel value q_2' of said pixel second next closest to said block boundary in said corresponding line of pixels.

14. (Original) The user equipment according to claim 13, wherein
said second offset calculator is configured to calculate said second offset to be equal to $((p_2 + p_0 + 1) \gg 1) - p_1 + \Delta \gg 1$, wherein $\gg$ denotes a right shift operation; and
said third offset calculator is configured to calculate said third offset to be equal to $((q_2 + q_0 + 1) \gg 1) - q_1 - \Delta \gg 1$.

15. (Currently Amended) The user equipment according to claim 13, wherein the deblocking filter unit further comprises a third clipping unit configured to clip said second offset to be within an interval of $-t_{C2}$ and t_{C2} by setting said second offset to be equal to $-t_{C2}$ if said second offset is smaller than $-t_{C2}$ and by setting said second offset to be equal to t_{C2} if said second offset is larger than t_{C2} , wherein t_{C2} is a threshold value that is dependent on a quantization parameter value assigned to said block, and to clip said third offset within an interval of $-t_{C2}$ and t_{C2} by setting said third offset to be equal to $-t_{C2}$ if said third offset is smaller than $-t_{C2}$ and by setting said third offset to be equal to t_{C2} if said third offset is larger than t_{C2} .

16. (Original) The user equipment according to claim 13, wherein the user equipment further comprises a second clipping unit configured to clip said modified pixel value p_1' of said pixel next closest to said block boundary in said line of pixels to be within an interval of zero and a defined maximum value by setting said modified pixel value p_1' of said pixel next closest to said block boundary in said line of pixels to be equal to zero if said modified pixel value p_1' of said pixel next closest to said block boundary in said line of pixels is smaller than zero and by setting said modified pixel value p_1' of said pixel next closest to said block boundary in said line of pixels to be equal to said defined maximum value if said modified pixel value p_1' of said pixel next closest to said block boundary in said line of pixels is larger than said defined maximum value, and

to clip said modified pixel value $q1'$ of said pixel next closest to said block boundary in said corresponding line of pixels to be within an interval of zero and said defined maximum value by setting said modified pixel value $q1'$ of said pixel next closest to said block boundary in said corresponding line of pixels to be equal to zero if said modified pixel value $q1'$ of said pixel next closest to said block boundary in said corresponding line of pixels is smaller than zero and by setting said modified pixel value $q1'$ of said pixel next closest to said block boundary in said corresponding line of pixels to be equal to said defined maximum if said modified pixel value $q1'$ of said pixel next closest to said block boundary in said corresponding line of pixels is larger than said defined maximum value.

17. (Original) The user equipment according to claim 13, wherein the deblocking filter unit further comprises:

a fourth offset calculator configured to calculate a fourth offset to be based on $(p3+p1-2 \times p2+2 \times \Delta_{p1})/4$, wherein $p3$ denotes a pixel value of a pixel third next closest to said block boundary in said line of pixels and Δ_{p1} denotes said second offset; and a fifth offset calculator configured to calculate a fifth offset to be based on $(q3+q1-2 \times q2+2 \times \Delta_{q1})/4$, wherein $q3$ denotes a pixel value of a pixel third closest to said block boundary in said corresponding line of pixels and Δ_{q1} denotes said third offset,

wherein said pixel value modifier is configured to modify said pixel value $p2$ of said pixel second next closest to said block boundary in said line of pixels by adding said fourth offset to said pixel value $p2$ of said pixel second next closest to said block boundary in said line of pixels to form a modified pixel value $p2'$ of said pixel second next closest to said block boundary in said line of pixels, and to modify said pixel value $q2$ of said pixel second next closest to said block boundary in said corresponding line of pixels by adding said fifth offset to said pixel value $q2$ of said pixel second next closest to said block boundary in said corresponding line of pixels to form a modified pixel value $q2'$ of said pixel second next closest to said block boundary in said corresponding line of pixels.

18. (Currently Amended) The user equipment according to claim 17, wherein
said fourth offset calculator is configured to calculate ~~calculating~~ said fourth offset to be
equal to $((p_3 + p_1 + 1) \gg 1) - p_2 + \Delta_{p_1} \gg 1$, wherein $\gg$ denotes a right shift operation; and
said fifth offset calculator is configured to calculate said fifth offset to be equal to
 $((q_3 + q_1 + 1) \gg 1) - q_2 + \Delta_{q_1} \gg 1$.

REMARKS

Claims 1-18 are pending in the application. Claims 1 and 10 are independent. No new matter has been added by the amendments. Applicant respectfully requests reconsideration.

I. Double Patenting

Solely to expedite prosecution of the present application to allowance, Applicant submits a Terminal Disclaimer with respect to US 8,526,509.

II. Rejection of Claims Under 35 U.S.C. §101

Claims 1-18 stand rejected under 35 U.S.C. §101. Applicant requests reconsideration.

There is a two-part test for determining whether an invention is patent eligible under section 101 -- the first part of the test is to determine whether the claimed invention is directed to a “judicial exception,” such as an abstract idea; if the claimed invention is determined to be directed to a judicial exception, then the second part of the test is to determine whether the claims fail to include an “inventive concept.” *Alice Corp. v. CLS Bank Int'l*, 134 S. Ct. 2347, 2354 (2014). A claim is invalid under section 101 only if it satisfies both prongs of the two-part test (e.g., the claim is directed to an abstract idea and the claim does not include an inventive concept).

In rejecting the pending claims under section 101, the Office did not apply this test. Instead, the Office applied the no longer valid “useful, concrete, and tangible result” test (a.k.a., the “State Street” test). *See, e.g., In re Bilski*, 545 F.3d 943, 88 U.S.P.Q.2d 1385 (Fed. Cir. 2008) (Holding that the “useful, concrete and tangible result” test of State Street should no longer be relied on.).

Applicant submits that, in this case, the claims are not directed to an abstract idea, and, moreover, the claims include an inventive concept. In short, the claims fail both prongs of the

two-part test, and, therefore, the claims are patent eligible for at least these two independent reasons.

1) The Claims are not Directed to an Abstract Idea

The claims are not directed to an abstract idea because the claims recite specific features that provide a specific improvement over prior systems. (*See, e.g., Core Wireless Licensing S.A.R.L. v. LG Electronics, Inc.*, 880 F.3d 1356, 1363 (Fed. Cir. 2018) (holding the claims to be patent eligible because “[the] claims recite a specific improvement over prior systems, resulting in an improved user interface for electronic devices.”)).

For example, claim 1 provides the specific features of:

calculating a first offset to be equal to $(9 \times (q_0 - p_0) - 3 \times (q_1 - p_1) + 8) \gg 4$, wherein $\gg$ denotes a right shift operation, p_0 denotes a pixel value of a pixel closest to said block boundary in a line of pixels in said block, wherein said line of pixels is perpendicular to said block boundary, p_1 denotes a pixel value of a pixel next closest to said block boundary in said line of pixels, q_0 denotes a pixel value of a pixel closest to said block boundary in a corresponding line of pixels in said neighboring block, wherein said corresponding line of pixels is perpendicular to said block boundary and q_1 denotes a pixel value of a pixel next closest to said block boundary in said corresponding line of pixels;

modifying said pixel value p_0 of said pixel closest to said block boundary in said line of pixels by adding said first offset to said pixel value p_0 of said pixel closest to said block boundary in said line of pixels to form a modified pixel value p_0' of said pixel closest to said block boundary in said line of pixels; and

modifying said pixel value q_0 of said pixel closest to said block boundary in said corresponding line of pixels by subtracting said first offset from said pixel value q_0 of said pixel closest to said block boundary in said corresponding line of pixels to form a modified pixel value q_0' of said pixel closest to said block boundary in said corresponding line of pixels.

These specific, claimed features allow for the improvement realized by the invention.

Specifically, the claimed features enable “reducing blocking artifacts at a block boundary between

a block of pixels and a neighboring block of pixels in a video frame.” (Specification at paragraph 0023). Moreover, “[t]he present embodiments enable *efficient reduction in blocking artifacts and also have good low-pass characteristics*.” (Specification at paragraph 0049 (emphasis added)). As explained in the Background section, the prior art suffers from not having “good low-pass characteristics.” (Specification at paragraph 0019). The claimed embodiments overcome this problem. (See Specification at 0049 (“[t]he present embodiments enable . . . *good low-pass characteristics*”)).

Because the claims require *specific* features and these specific features *improve* upon existing prior art technology, the claims are not abstract. (*See, e.g., Core Wireless Licensing S.A.R.L. v. LG Electronics, Inc.*, 880 F.3d 1356, 1363 (Fed. Cir. 2018) (holding the claims to be patent eligible because “[the] claims recite a specific improvement over prior systems, resulting in an improved user interface for electronic devices.”)). Accordingly, the first part of the two-part test is not met in this case since the claims are not directed to an abstract idea.

2) The Claims Include an Inventive Concept

Even if the claims are directed to an abstract idea (which they are not), the claims would still be patent eligible because the claims include an inventive concept as demonstrated by the fact that no art rejection has been made against the pending claims.

For at least the above reasons, the section 101 rejection should be withdrawn.

CONCLUSION

All of the stated grounds of objection and rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider all presently outstanding objections and rejections, and that they be withdrawn.

Applicant believes that a full and complete reply has been made to the outstanding Office Action and, as such, the present application is in condition for allowance.

If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

If any fees are required, such as, but not limited to, any extension of time fee under 37 C.F.R. 1.17, Applicant hereby petitions for an extension of time, if necessary, and authorizes the Office to charge all required fees to deposit account number 02-2135.

RESPECTFULLY SUBMITTED,					
<i>NAME AND REG. #</i>	Brian Rosenbloom, Registration # 41,276				
<i>SIGNATURE</i>	<i>/Brian Rosenbloom/</i>		<i>DATE</i>	2018-04-23	
<i>Address</i>	Rothwell, Figg, Ernst & Manbeck, P.C. Suite 800, 607 14 th Street, N.W. Washington, D.C. 20005				
<i>Email:</i>	brosenbloom@rfem.com	<i>Tel:</i>	202-626-3531	<i>Fax:</i>	202-783-6031

Electronic Patent Application Fee Transmittal

Application Number:	15639229			
Filing Date:	30-Jun-2017			
Title of Invention:	DEBLOCKING FILTERING			
First Named Inventor/Applicant Name:	Andrey NORKIN			
Filer:	Brian S. Rosenbloom/Sabrina Mayfield			
Attorney Docket Number:	3602-518US5			
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Miscellaneous:				
STATUTORY OR TERMINAL DISCLAIMER	1814	1	160	160
Total in USD (\$)				160

Electronic Acknowledgement Receipt

EFS ID:	32415957
Application Number:	15639229
International Application Number:	
Confirmation Number:	2772
Title of Invention:	DEBLOCKING FILTERING
First Named Inventor/Applicant Name:	Andrey NORKIN
Customer Number:	6449
Filer:	Brian S. Rosenbloom/Sabrina Mayfield
Filer Authorized By:	Brian S. Rosenbloom
Attorney Docket Number:	3602-518US5
Receipt Date:	23-APR-2018
Filing Date:	30-JUN-2017
Time Stamp:	17:36:10
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	\$ 160
RAM confirmation Number	042418INTEFSW17370500
Deposit Account	
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

File Listing:					
Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Terminal Disclaimer Filed	3602-518US5_TerminalDisclaimer.pdf	749594	no	2
			2f104797d8c6c14362919282d0b6c44e0352d244		
Warnings:					
Information:					
2	Amendment/Req. Reconsideration-After Non-Final Reject	3602-518US5_Reply.pdf	96385	no	18
			e6f6dfb332bef9051943c3443a2e4b84d31fa818		
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	30514	no	2
			ef2639fa82bb12b3321c00178b9505cc3b2f5959		
Warnings:					
Information:					
Total Files Size (in bytes):			876493		
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.					

**TERMINAL DISCLAIMER TO OBIATE A DOUBLE PATENTING
REJECTION OVER A "PRIOR" PATENT**

Docket Number (Optional)
3602-518US5

In re Application of: Andrey NORKIN

Application No.: 15/639,229

Filed: June 30, 2017

For: DEBLOCKING FILTERING

The applicant, Telefonaktiebolaget LM Ericsson (publ), owner of 100 percent interest in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of **prior patent** No. 8,526,509 as the term of said **prior patent** is presently shortened by any terminal disclaimer. The applicant hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the **prior patent** are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the applicant does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term of the **prior patent**, "as the term of said **prior patent** is presently shortened by any terminal disclaimer," in the event that said **prior patent** later:

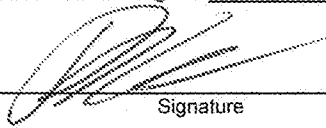
- expires for failure to pay a maintenance fee;
- is held unenforceable;
- is found invalid by a court of competent jurisdiction;
- is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321;
- has all claims canceled by a reexamination certificate;
- is reissued; or
- is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

Check either box 1 or 2 below, if appropriate.

1. ☐ The undersigned is the applicant. If the applicant is an assignee, the undersigned is authorized to act on behalf of the assignee.

I hereby acknowledge that any willful false statements made are punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

2. ☒ The undersigned is an attorney or agent of record. Reg. No. 41,276



Signature

2018-04-23

Date

Brian S. Rosenbloom
Typed or printed name

Attorney of Record
Title

202-783-6040
Telephone Number

- ☒ Terminal disclaimer fee under 37 CFR 1.20(d) included.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

This collection of information is required by 37 CFR 1.321. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875				Application or Docket Number 15/639,229		Filing Date 06/30/2017		☐ To be Mailed	
ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO									
APPLICATION AS FILED - PART I									
		(Column 1)	(Column 2)						
FOR		NUMBER FILED	NUMBER EXTRA		RATE (\$)		FEE (\$)		
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))		N/A	N/A		N/A				
☐ SEARCH FEE (37 CFR 1.16(k), (l), or (m))		N/A	N/A		N/A				
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))		N/A	N/A		N/A				
TOTAL CLAIMS (37 CFR 1.16(i))		minus 20 = *		x \$80 =					
INDEPENDENT CLAIMS (37 CFR 1.16(h))		minus 3 = *		x \$420 =					
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))		If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).							
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))									
* If the difference in column 1 is less than zero, enter "0" in column 2.					TOTAL				
APPLICATION AS AMENDED - PART II									
		(Column 1)		(Column 2)	(Column 3)				
AMENDMENT	04/23/2018	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)		ADDITIONAL FEE (\$)	
	Total (37 CFR 1.16(i))	* 18	Minus	** 20	= 0	x \$100 =		0	
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0	x \$460 =		0	
	☐ Application Size Fee (37 CFR 1.16(s))								
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))								
						TOTAL ADD'L FEE		0	
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)		ADDITIONAL FEE (\$)	
	Total (37 CFR 1.16(i))	*	Minus	**	=	x \$0 =			
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x \$0 =			
	☐ Application Size Fee (37 CFR 1.16(s))								
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))								
						TOTAL ADD'L FEE			
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.						LIE			
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".						Brenda V Harrison			
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".									
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.									

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Application Number 	Application/Control No. 15/639,229	Applicant(s)/Patent under Reexamination NORKIN ET AL.	
Document Code - DISQ		Internal Document – DO NOT MAIL	

TERMINAL DISCLAIMER	☒ APPROVED	☐ DISAPPROVED
Date Filed : 4/23/18	This patent is subject to a Terminal Disclaimer	

Approved/Disapproved by:
Lawana Hixon

U.S. Patent and Trademark Office



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

6449 7590 07/23/2018
ROTHWELL, FIGG, ERNST & MANBECK, P.C.
607 14th Street, N.W.
SUITE 800
WASHINGTON, DISTRICT OF COLUMBIA 20005
UNITED STATES OF AMERICA

EXAMINER

TORRENTE, RICHARD T

ART UNIT

PAPER NUMBER

2485

DATE MAILED: 07/23/2018

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/639,229	06/30/2017	Andrey NORKIN	3602-518US5	2772

TITLE OF INVENTION: DEBLOCKING FILTERING

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$1000	\$0.00	\$0.00	\$1000	10/23/2018

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: **Mail** **Mail Stop ISSUE FEE**
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

6449 7590 07/23/2018
 ROTHWELL, FIGG, ERNST & MANBECK, P.C.
 607 14th Street, N.W.
 SUITE 800
 WASHINGTON, DISTRICT OF COLUMBIA 20005
 UNITED STATES OF AMERICA

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/639,229	06/30/2017	Andrey NORKIN	3602-518US5	2772

TITLE OF INVENTION: DEBLOCKING FILTERING

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$1000	\$0.00	\$0.00	\$1000	10/23/2018

EXAMINER	ART UNIT	CLASS-SUBCLASS
TORRENTE, RICHARD T	2485	375-240250

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list

(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,

(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
 2 _____
 3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

(B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☐ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

☐ Issue Fee

☐ Publication Fee (No small entity discount permitted)

☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): (**Please first reapply any previously paid issue fee shown above**)

☐ A check is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☐ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27

☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____

Date _____

Typed or printed name _____

Registration No. _____



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/639,229	06/30/2017	Andrey NORKIN	3602-518US5	2772
6449	7590	07/23/2018	EXAMINER	
ROTHWELL, FIGG, ERNST & MANBECK, P.C. 607 14th Street, N.W. SUITE 800 WASHINGTON, DISTRICT OF COLUMBIA 20005 UNITED STATES OF AMERICA			TORRENTE, RICHARD T	
			ART UNIT	PAPER NUMBER
			2485	
DATE MAILED: 07/23/2018				

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 15/639,229	Applicant(s) NORKIN et al.	
	Examiner RICHARD T TORRENTE	Art Unit 2485	AIA Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to the amendment filed 4/23/18.
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☒ The allowed claim(s) is/are 1-18. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a) ☐ All b) ☐ Some *c) ☐ None of the:

1. ☐ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. _____.

3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

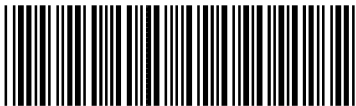
Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892) 2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____. 3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____. 4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____.	5. ☐ Examiner's Amendment/Comment 6. ☐ Examiner's Statement of Reasons for Allowance 7. ☐ Other _____.
---	---

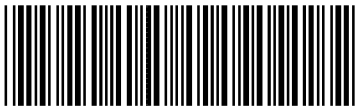
/RICHARD T TORRENTE/
Primary Examiner, Art Unit 2485

Issue Classification 	Application/Control No. 15/639,229	Applicant(s)/Patent Under Reexamination NORKIN et al.
	Examiner RICHARD T TORRENTE	Art Unit 2485

CPC						
Symbol					Type	Version
H04N	/	19	/	865	F	2014-11-01
H04N	/	19	/	176	I	2014-11-01
H04N	/	19	/	61	I	2014-11-01
H04N	/	19	/	117	I	2014-11-01
H04N	/	19	/	14	I	2014-11-01
H04N	/	19	/	82	I	2014-11-01
H04N	/	19	/	86	I	2014-11-01
H04N	/	19	/	80	I	2014-11-01
H04N	/	19	/	182	I	2014-11-01

CPC Combination Sets							
Symbol				Type	Set	Ranking	Version
	/		/				

NONE (Assistant Examiner) _____ (Date) _____		Total Claims Allowed: 18	
/RICHARD T TORRENTE/ Primary Examiner, Art Unit 2485 (Primary Examiner) _____ (Date) _____		06 July 2018 (Date)	O.G. Print Claim(s) 1 O.G. Print Figure 1

<i>Issue Classification</i> 	Application/Control No. 15/639,229	Applicant(s)/Patent Under Reexamination NORKIN et al.
	Examiner RICHARD T TORRENTE	Art Unit 2485

INTERNATIONAL CLASSIFICATION			
CLAIMED			
H04N	/	7	/ 12
NON-CLAIMED			
	/		/

US ORIGINAL CLASSIFICATION	
CLASS	SUBCLASS
375	240.25

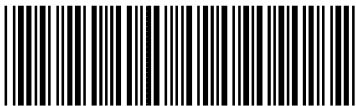
CROSS REFERENCES(S)						
CLASS	SUBCLASS (ONE SUBCLASS PER BLOCK)					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	18	
/RICHARD T TORRENTE/ Primary Examiner, Art Unit 2485	06 July 2018	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

<i>Issue Classification</i> 	Application/Control No. 15/639,229	Applicant(s)/Patent Under Reexamination NORKIN et al.
	Examiner RICHARD T TORRENTE	Art Unit 2485

☒ Claims renumbered in the same order as presented by applicant ☐ CPA ☒ T.D. ☐ R.1.47															
CLAIMS															
Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original

NONE (Assistant Examiner) _____ (Date) _____		Total Claims Allowed: 18	
/RICHARD T TORRENTE/ Primary Examiner, Art Unit 2485 (Primary Examiner) _____ (Date) 06 July 2018		O.G. Print Claim(s) 1	O.G. Print Figure 1

Search Notes 	Application/Control No. 15/639,229	Applicant(s)/Patent Under Reexamination NORKIN et al.
	Examiner RICHARD T TORRENTE	Art Unit 2485

CPC - Searched*		
Symbol	Date	Examiner
H04N 19/865	1/20/18	RT
H04N 19/176	1/20/18	RT

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
375	240.25	1/20/18	RT

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Searched EAST	1/20/18	RT
Searched CPC	1/20/18	RT
Searched inventors	1/20/18	RT
Updated search	7/6/18	RT

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
	General interference and search of claims (USPGPUB , UPAD)	7/6/18	RT

/RICHARD T TORRENTE/ Primary Examiner, Art Unit 2485	
---	--

Bibliographic Data

Application No: 15/639,229

Foreign Priority claimed: ☐ Yes ☒ No

35 USC 119 (a-d) conditions met: ☐ Yes ☒ No ☐ Met After Allowance

Verified and Acknowledged: /RICHARD T TORRENTE/

Examiner's Signature

Initials

Title: DEBLOCKING FILTERING

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
06/30/2017	375	2485	3602-518US5
RULE			

APPLICANTS

Telefonaktiebolaget L M Ericsson (publ), Stockholm, SWEDEN

INVENTORS

Andrey NORKIN Solna, SWEDEN

Kenneth ANDERSSON Gavle, SWEDEN

Rickard SJÖBERG Stockholm, SWEDEN

CONTINUING DATA

This application is a CON of 15008013 01/27/2016 PAT 9743115

15008013 is a CON of 13955448 07/31/2013 PAT 9407912

13955448 is a CON of 13583437 09/07/2012 PAT 8526509

13583437 is a 371 of PCT/SE2011/051199 10/06/2011

PCT/SE2011/051199 has PRO of 61432751 01/14/2011

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

07/10/2017

STATE OR COUNTRY

SWEDEN

ADDRESS

ROTHWELL, FIGG, ERNST & MANBECK, P.C.

607 14th Street, N.W.

SUITE 800

WASHINGTON, DC 20005

UNITED STATES

FILING FEE RECEIVED

\$1,600

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), to: **Mail** Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
or Fax (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

6449 7590 07/23/2018
ROTHWELL, FIGG, ERNST & MANBECK, P.C.
607 14th Street, N.W.
SUITE 800
WASHINGTON, DISTRICT OF COLUMBIA 20005
UNITED STATES OF AMERICA

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/639,229	06/30/2017	Andrey NORKIN	3602-518US5	2772

TITLE OF INVENTION: DEBLOCKING FILTERING

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$1000	\$0.00	\$0.00	\$1000	10/23/2018

EXAMINER	ART UNIT	CLASS-SUBCLASS
TORRENTE, RICHARD T	2485	375-240250

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. Use of a Customer Number is required.

2. For printing on the patent front page, list
 (1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
 (2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Rothwell, Figg,
 2 Ernst & Manbeck, p.c.
 3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE

TELEFONAKTIEBOLAGET LM ERICSSON (PUBL)

(B) RESIDENCE: (CITY AND STATE OR COUNTRY)

Stockholm, Sweden

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:

- ☒ Issue Fee
☐ Publication Fee (No small entity discount permitted)
☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): (Please first reapply any previously paid issue fee shown above)

- ☐ A check is enclosed.
☐ Payment by credit card. Form PTO-2038 is attached.
☒ The director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number 022135 (enclose an extra copy of this form).

5. Change in Entity Status (from status indicated above)

- ☐ Applicant certifying micro entity status. See 37 CFR 1.29
☐ Applicant asserting small entity status. See 37 CFR 1.27
☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
 NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
 NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature Brian S. Rosenbloom
 Typed or printed name Brian S. Rosenbloom

Date 2018-10-18
 Registration No. 41276

Electronic Patent Application Fee Transmittal				
Application Number:		15639229		
Filing Date:		30-Jun-2017		
Title of Invention:		DEBLOCKING FILTERING		
First Named Inventor/Applicant Name:		Andrey NORKIN		
Filer:		Brian S. Rosenbloom/Sheda Vasseghi		
Attorney Docket Number:		3602-518US5		
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	1501	1	1000	1000

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				1000

Electronic Acknowledgement Receipt

EFS ID:	34047608
Application Number:	15639229
International Application Number:	
Confirmation Number:	2772
Title of Invention:	DEBLOCKING FILTERING
First Named Inventor/Applicant Name:	Andrey NORKIN
Customer Number:	6449
Filer:	Brian S. Rosenbloom/Sheda Vasseghi
Filer Authorized By:	Brian S. Rosenbloom
Attorney Docket Number:	3602-518US5
Receipt Date:	18-OCT-2018
Filing Date:	30-JUN-2017
Time Stamp:	13:27:45
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	\$ 1000
RAM confirmation Number	101818INTEFSW00012526022135
Deposit Account	022135
Authorized User	Sheda Vasseghi

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)
 37 CFR 1.20 (Post Issuance fees)
 37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	3602_518US5_IF.pdf	93996	no	1
			d7cfe5cbd9d046e9302d17d0fde6d0ac0af5253f		

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	30353	no	2
			3900a1ea13f184feacd35a087c0133f75d1e384		

Warnings:

Information:

Total Files Size (in bytes):	124349
-------------------------------------	--------

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Doc code: IDS

Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)

Approved for use through 07/31/2012. OMB 0651-0031

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		
	Filing Date		
	First Named Inventor	Andrey NORKIN	
	Art Unit		
	Examiner Name		
	Attorney Docket Number	3602-518US5	

U.S.PATENTS						
Examiner Initial*	Cite No	Patent Number	Kind Code ¹	Issue Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	6167164		2000 ~~2000~~ -12-26	Lee	

Change(s) applied
to document,
/D.M./
8/17/2018

If you wish to add additional U.S. Patent citation information please click the Add button.

U.S.PATENT APPLICATION PUBLICATIONS						
Examiner Initial*	Cite No	Publication Number	Kind Code ¹	Publication Date	Name of Patentee or Applicant of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	20080117980	A1	2008-05-22	Hung Ching-Yu et al	
	2	20080123750	A1	2008-05-20	Bronstein et al	
	3	20040101059	A1	2004-05-27	Joch et al.	
	4	20060078048	A1	2006-04-13	Bjontegaard	
	5	20050147319	A1	2005-07-07	Deshpande et al.	



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/639,229	11/27/2018	10142659	3602-518US5	2772

6449 7590 11/07/2018
ROTHWELL, FIGG, ERNST & MANBECK, P.C.
607 14th Street, N.W.
SUITE 800
WASHINGTON, DC 20005

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b) (application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (<http://pair.uspto.gov>).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site <http://pair.uspto.gov> for additional applicants):

Andrey NORKIN, Solna, SWEDEN;
Telefonaktiebolaget L M Ericsson (publ), Stockholm, SWEDEN;
Kenneth ANDERSSON, Gavle, SWEDEN;
Rickard SJÖBERG, Stockholm, SWEDEN;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

Under the Paperwork Reduction Act of 1995 no persons are required to respond to a collection of information unless it displays a valid OMB control number

PATENT - POWER OF ATTORNEY OR REVOCATION OF POWER OF ATTORNEY WITH A NEW POWER OF ATTORNEY AND CHANGE OF CORRESPONDENCE ADDRESS	Patent Number	10142659
	Issue Date	11-27-2018
	First Named Inventor	Andrey Norkin
	Title	DEBLOCKING FILTERING
	Attorney Docket No.	VEER00106US5

I hereby revoke all previous powers of attorney given in the above-identified patent.

☐ A Power of Attorney is submitted herewith.

OR

☒ I hereby appoint Practitioner(s) associated with the Customer Number identified in the box at right as my/our attorney(s) or agent(s) with respect to the patent identified above, and to transact all business in the United States Patent and Trademark Office connected therewith:

47391

OR

☐ I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s) with respect to the patent identified above, and to transact all business in the United States Patent and Trademark Office connected therewith:

Practitioner(s) Name	Registration Number

Please recognize or change the correspondence address for the above-identified patent to:

☒ The address associated with the above-identified Customer Number.

OR

☐ The address associated with the Customer Number identified in the box at right:

OR

☐ Firm or

☐ Individual Name

Address

City

State

Zip

Country

Telephone

Email

I am the:

☐ Applicant.

OR

☒ Patent owner.

Statement under 37 CFR 3.73(c) (Form PTO/AIA/96) submitted herewith or filed on _____.

SIGNATURE of Applicant or Patent Owner

Signature	/Kenneth A. McClure/	Date	04/05/2019
Name	Kenneth A. McClure	Telephone	214-765-9500
Title and Company	Vice President, Patent Development		

NOTE: Signatures of all the applicants or patent owners of the entire interest or their representative(s) are required. If more than one signature is required, submit multiple forms, check the box below, and identify the total number of forms submitted in the blank below.

☐ A total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public, which is to update (and by the USPTO to process) the file of a patent or reexamination proceeding. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)Applicant/Patent Owner: VELOS MEDIA, LLCApplication No./Patent No.: 10142659Filed/Issue Date: 11-27-2018Titled: DEBLOCKING FILTERINGVELOS MEDIA, LLC, a Corporation

(Name of Assignee)

(Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☒ The assignee of the entire right, title, and interest.
2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):
- ☐ The extent (by percentage) of its ownership interest is ____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.
- ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (e.g., bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

- A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.
- B. ☒ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: SJOBERG, R.; NORKIN, A.; ANDERSSON, K. To: TELEFONAKTIEBOLAGET L M ERICSSON (PUBL)The document was recorded in the United States Patent and Trademark Office at
Reel 042975, Frame 0405, or for which a copy thereof is attached.2. From: TELEFONAKTIEBOLAGET L M ERICSSON (PUBL) To: ERICSSON LLCThe document was recorded in the United States Patent and Trademark Office at
Reel 047526, Frame 0463, or for which a copy thereof is attached.

[Page 1 of 2]

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

STATEMENT UNDER 37 CFR 3.73(c)3. From: ERICSSON LLC To: VELOS MEDIA, LLC

The document was recorded in the United States Patent and Trademark Office at
 Reel 047526, Frame 0553, or for which a copy thereof is attached.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
 Reel _____, Frame _____, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
 Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
 Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☒ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Kenneth A. McClure/

04/05/2019

Signature

Date

Kenneth A. McClure

62886

Printed or Typed Name

Title or Registration Number

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	35644037
Application Number:	15639229
International Application Number:	
Confirmation Number:	2772
Title of Invention:	DEBLOCKING FILTERING
First Named Inventor/Applicant Name:	Andrey NORKIN
Customer Number:	6449
Filer:	Kenneth A. McClure/Kara Coffman
Filer Authorized By:	Kenneth A. McClure
Attorney Docket Number:	3602-518US5
Receipt Date:	05-APR-2019
Filing Date:	30-JUN-2017
Time Stamp:	15:39:39
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
------------------------	----

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	VEER00106US5_PoA_CoA_Velo s.pdf	130875 48cd3309856181329ec62a12250d2f60a94 3b679	no	2

Warnings:

Information:					
2	Assignee showing of ownership per 37 CFR 3.73	VEER00106US5_Statement_under_37_CFR_373_Velos.pdf	121570	no	3
			209d394489c238651a9b5ca2f30f15348ec1c504		
Warnings:					
Information:					
Total Files Size (in bytes):				252445	
This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503. <u>New Applications Under 35 U.S.C. 111</u> If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application. <u>National Stage of an International Application under 35 U.S.C. 371</u> If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course. <u>New International Application Filed with the USPTO as a Receiving Office</u> If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.					



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/639,229	06/30/2017	Andrey NORKIN	VEER00106US5

CONFIRMATION NO. 2772

POA ACCEPTANCE LETTER



OC000000107263014

47391
KENNETH A. MCCLURE
MARCONI
1717 MCKINNEY AVENUE
STE 1050
DALLAS, TX 75202

Date Mailed: 04/10/2019

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 04/05/2019.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at (571) 272-4000 or (571) 272-4200 or 1-888-786-0101.

/byemane/



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/639,229	06/30/2017	Andrey NORKIN	3602-518US5

CONFIRMATION NO. 2772

POWER OF ATTORNEY NOTICE

6449
ROTHWELL, FIGG, ERNST & MANBECK, P.C.
607 14th Street, N.W.
SUITE 800
WASHINGTON, DC 20005



Date Mailed: 04/10/2019

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 04/05/2019.

- The Power of Attorney to you in this application has been revoked by the assignee who has intervened as provided by 37 CFR 3.71. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at (571) 272-4000 or (571) 272-4200 or 1-888-786-0101.

/byemane/