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Application Number	Not Yet Known
Filing Date	Not Yet Known
First Named Inventor	Philip J. Pietraski
Title	DETECTION, AVOIDANCE AND/OR CORRECTION OF PROBLEMATIC PUNCTURING PATTERNS IN PARITY BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES
Art Unit	Not Yet Known
Examiner Name	Not Yet Known
Attorney Docket Number	I-2-0526US06

SIGNATURE of Applicant or Patent Practitioner

Signature	/Wesley T. McMichael/	Date (Optional)	June 10, 2014
Name	Wesley T. McMichael	Registration Number	56,982
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)	InterDigital Technology Corporation		
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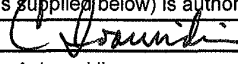
I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

InterDigital Technology Corporation

- ☐ Inventor or Joint Inventor (title not required below)
- ☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)
- ☒ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)
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SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature		Date (Optional)	13 March 2014
Name	Christos A. Ioannidi		
Title	Patent Executive; InterDigital Technology Corporation		

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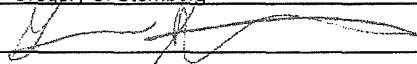
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**DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN
APPLICATION DATA SHEET (37 CFR 1.76)**

Title of Invention	DETECTION, AVOIDANCE AND/OR CORRECTION OF PROBLEMATIC PUNCTURING PATTERNS IN PARITY BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES
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 <u>13/744,984</u> filed on <u>January 18, 2013</u> 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 have reviewed and understand the contents of the above-identified application, including the claims. I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in 37 CFR 1.56. 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. WARNING: Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.	
LEGAL NAME OF INVENTOR	
Inventor: <u>Gregory S. Sternberg</u> Date: <u>28 March 2013</u> Signature: 	
Note: An application data sheet (PTO/AIA/14 or equivalent), including naming the entire inventive entity, must accompany this form. Use an additional form for each additional inventor.	

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2215571-1

Electronic Patent Application Fee Transmittal				
Application Number:				
Filing Date:				
Title of Invention:		DETECTION, AVOIDANCE AND/OR CORRECTION OF PROBLEMATIC PUNCTURING PATTERNS IN PARITY BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES		
First Named Inventor/Applicant Name:		Philip J. Pietraski		
Filer:		Wesley T. McMichael/Belinda Fields		
Attorney Docket Number:		I-2-0526US06		
Filed as Large Entity				
Utility under 35 USC 111(a) Filing Fees				
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:	19261458
Application Number:	14300734
International Application Number:	
Confirmation Number:	1001
Title of Invention:	DETECTION, AVOIDANCE AND/OR CORRECTION OF PROBLEMATIC PUNCTURING PATTERNS IN PARITY BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES
First Named Inventor/Applicant Name:	Philip J. Pietraski
Customer Number:	24374
Filer:	Wesley T. McMichael/Belinda Fields
Filer Authorized By:	Wesley T. McMichael
Attorney Docket Number:	I-2-0526US06
Receipt Date:	10-JUN-2014
Filing Date:	
Time Stamp:	15:55:41
Application Type:	Utility under 35 USC 111(a)

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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		I_2_0526US06_Application_20140610.PDF	234082 fcc7763d55f6be30726f44db8cb856cf0ee0707	yes	41
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Specification		1	38	
	Claims		39	40	
	Abstract		41	41	
Warnings:					
Information:					
2	Drawings-only black and white line drawings	I_2_0526US06_Drawings_20140610.PDF	247238 a5cfeaa6a280db12caed55daeb0037967d47b2e2	no	12
Warnings:					
Information:					
3	Application Data Sheet	I_2_0526US06_ADS_20140610.PDF	1561996 ae5a518d129222b02d3c8544b39fc6fc2b1e91fc	no	7
Warnings:					
Information:					
4	Power of Attorney	I_2_0526US06_Power_Of_Attorney_20140610.PDF	292934 2d3182b723f1d7ab8b20389a5a296b3baa4f405f	no	2
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6	Fee Worksheet (SB06)	fee-info.pdf	33338 d25dbde72ead61ad16c279474999253d7f5c9d7f	no	2
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New International Application Filed with the USPTO as a Receiving Office

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DETECTION, AVOIDANCE AND/OR CORRECTION OF
PROBLEMATIC PUNCTURING PATTERNS IN PARITY
BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. Patent Application Serial No. 13/744,984, filed on January 18, 2013, which is a continuation of U.S. Patent Application Serial No. 13/309,962, filed on December 2, 2011, which issued as U.S. Patent No. 8,359,520 on January 22, 2013; which is a continuation of U.S. Patent Application Serial No. 11/974,381 filed on October 12, 2007, which issued as U.S. Patent No. 8,074,143 on December 6, 2011; which is a continuation of U.S. Patent Application Serial No. 10/725,779, filed on December 2, 2003, which issued as U.S. Patent No. 7,293,217 on November 6, 2007, which claims the benefit of U.S. Provisional Patent Applications Serial No. 60/434,232, filed on December 16, 2002, Serial No. 60/444,068, filed on January 30, 2003, Serial No. 60/470,921, filed on May 15, 2003, and Serial No. 60/494,404 filed on August 11, 2003, which are incorporated by reference herein as if fully set forth herein.

FIELD OF THE INVENTION

[0002] This invention generally relates to the use of Turbo codes in general, and, more particularly to a method for detecting and correcting performance degradation in punctured Turbo codes using a Turbo encoder.

BACKGROUND

[0003] Wireless communication systems are well known in the art. Generally, such systems comprise communication stations that transmit and receive wireless communication signals between each other. Typically, base stations are provided which are capable of conducting wireless concurrent communications with a plurality of subscriber stations. In Code Division Multiple Access (CDMA) systems specified by the Third Generation Partnership Project (3GPP), base stations are called Node Bs,

subscriber stations are called User Equipments (UE) and the wireless interface between the Node Bs and UEs is known as the Uu interface. Figure 1 illustrates a typical 3GPP CDMA system.

[0004] The Uu radio interface of a 3GPP communications system uses Transport Channels (TrCH) for transfer of user data and signaling between UEs and Node Bs. In 3GPP Time Division Duplex (TDD) communications, TrCH data is conveyed by one or more physical channels defined by mutually exclusive physical resources. TrCH data is transferred in sequential groups of Transport Blocks (TB) defined as Transport Block Sets (TBS). Each TBS is transmitted in a given Transmission Time Interval (TTI) which may span a plurality of consecutive system time frames. A typical system time frame is 10 milliseconds and TTIs are currently specified as spanning 1, 2, 4 or 8 of such time frames.

[0005] Figure 2 illustrates the processing of TrCHs in TTD mode into a Coded Composite TrCH (CCTrCH) and then into one or more physical channel data streams in accordance with 3GPP TS 25.222 v3.8.0. Starting with the TB of data, Cyclic Redundancy Check (CRC) bits are attached and TB concatenation and code block segmentation is performed. Convolution coding or turbo coding is then performed, but in some instances no coding is specified. The steps after coding, include radio frame equalization, a first interleaving, radio frame segmentation and rate matching. The radio frame segmentation divides the data over the number of frames in the specified TTI. The rate matching function operates by means of bit repetition or puncturing and defines the number of bits for each processed TrCH which are thereafter multiplexed to form a CCTrCH data stream.

[0006] The processing of the CCTrCH data stream includes bit scrambling, physical channel segmentation, a second interleaving and mapping onto one or more physical channels. The number of physical channels corresponds to the physical channel segmentation. For uplink transmissions, UE to Node B, the maximum number of physical channels for transmission of a CCTrCH is currently specified as two. For downlink transmissions, Node B to UEs, the maximum number of physical

channels for transmission of a CCTrCH is currently specified as sixteen. Each physical channel data stream is then spread with a channelization code and modulated for over air transmission on an assigned frequency.

[0007] In the reception/decoding of the TrCH data, the processing is essentially reversed by the receiving station. Accordingly, UE and Node B physical reception of TrCHs require knowledge of TrCH processing parameters to reconstruct the TBS data. For each TrCH, a Transport Format Set (TFS) is specified containing a predetermined number of Transport Formats (TF). Each TF specifies a variety of dynamic parameters, including TB and TBS sizes, and a variety of semi static parameters, including TTI, coding type, coding rate, rate matching parameter and CRC length. The predefined collection of TFSs for the TrCHs of a CCTrCH for a particular frame is denoted as a Transport Format Combination (TFC).

[0008] Receiving station processing is facilitated by the transmission of a Transport Format Combination Indicator (TFCI) for a CCTrCH. 3GPP optionally provides for "blind transport format detection" by the receiving station, in which case the receiving station considers the potential valid TFCIs. Where there is only one valid TFCI, that TFCI is used in either case.

[0009] In 3GPP, time slot transmissions are made in predefined bursts where the transmitted physical channel data is divided into a beginning time slot portion and an ending time slot portion. A selected midamble is included between the two physical channel data portions. The TFCI is currently specified as transmitted in two parts on either side of the midamble and also between the two physical channel data portions. Two examples from 3GPP TR 25.944 V3.5.0 are illustrated in Figures 3 and 4 respectively where the block labeled MA represents the midamble and the block labeled T represents the parts of the TFCI. In Figure 4, the CCTrCH is mapped to two physical channels, but only one physical channel includes the TFCI.

[0010] Figures 5A, 5B and 6 are diagrams of channel coding and multiplexing examples in accordance with 3GPP Frequency Division Duplex (FDD) specifications.

[0011] The various encoding steps implemented in communication systems play a key role in both performance and capacity of a wireless telecommunications systems. In particular, the turbo coding of the data being processed for wireless transmission plays a significant role for both TDD and FDD communications in a 3GPP system.

[0012] Turbo coding principles have found widespread applications in information theory and, in part, have entered into mainstream telecommunication theory and practice. These principles are used in error control, detection, interference suppression, equalization, and other communications-related areas. Turbo codes are a form of parallel, recursive systematic convolution codes, which can be used for channel coding and decoding in order to detect and correct errors that may occur in the transmission of digital data through different channels. Turbo codes are particularly useful for data transfers in which, under certain conditions, the data transfer rate can approach the theoretical limits of Shannon's Law. These favorable conditions generally include large block size transfers, which are particularly useful in mobile communications.

[0013] Figure 7 shows how particular codes created by puncturing exhibit poorer than expected performance. As much as a 4dB loss can be measured in the critical Signal-to-Noise Ratio (SNR) value.

[0014] Typically, high-rate Turbo codes are created by puncturing (i.e., eliminating) parity bits of a lower-rate code until the desired code rate is attained. Particular codes created by puncturing exhibit poorer than expected performance due to certain punctured bit patterns. Because the recursive encoding blocks in a Turbo encoder have an infinite impulse response, information about each systematic bit is distributed across many of the parity bits.

[0015] In any error control coding scheme that employs puncturing, the location of the punctured bits will have an impact on performance. This is because puncturing strings of successive bits can be viewed as burst errors by the decoder. All error control mechanisms can only correct burst errors that are less than some threshold. Therefore, it is important when designing the puncturing scheme that the burst error

correcting abilities of the code be considered. In the absence of specific knowledge of the error control coding scheme, a good rule is to minimize the maximum string of punctured bits. For high coding rates this corresponds to distributing the non-punctured bits uniformly across the transmitted block. Puncturing schemes that uniformly distribute the non-punctured bits can deleteriously interact with certain error control codes, causing a degradation of decoder performance.

[0016] Because the recursive encoding blocks in the Turbo encoder have infinite impulse response, information about each systematic bit is distributed across many of the parity bits. The impact of certain periodic non-puncture patterns in the parity bits can be qualitatively illustrated by considering how much information remains in the surviving parity bits.

[0017] Regions where performance of the punctured Turbo code is degraded can be determined by measuring how close the puncturing pattern is to being periodic with period related to the period of the semi-periodic impulse response of the recursive encoding blocks of the Turbo encoder.

[0018] For a 3GPP Turbo encoder, the constituent recursive encoders have an impulse response that is periodic with a period of 7 symbols for positive time (semi-periodic). This can readily be seen by interpretation of the encoder as an M-sequence generator, i.e., if the shift register starts in the zero state and a one is applied only at $t = 0$, then the encoder is exactly a Linear Feedback Shift Register (LFSR) with an associated 3rd order primitive polynomial and initial state {1 0 0}, thus a period $2^3 - 1 = 7$ M-sequence is generated for positive time.

[0019] The encoder is a Linear Time Invariant (LTI) system on a binary field. Therefore, the output of the encoder is a sum of shifted versions of the impulse response of the encoder, each shifted impulse response corresponding to the locations of the 1's in the TB. If we consider an input that is all 0's for $t > T$, then the output of the constituent recursive encoding block will also be semi-periodic for $t > T$.

[0020] Certain non-puncturing periods may result in a loss of distributed information about a small group of bits across the set of parity bits. For example, let

the TB consist of 7 bits followed by many zeros. Now consider the problem of trying to determine the seven bits by observation of the output of one encoder after heavy puncturing. Each observation is made at the output is a sum of a subset of the 7 bits, the subset being determined by the non-puncture period and the impulse response of the recursive encoding block. For most non-puncture patterns (those that have a period relatively prime with the period of the semi-periodic impulse response), sums over 7 different subsets can eventually be observed. Therefore, a system of 7 equations with 7 unknowns can be formed. Assuming they are linearly independent, the values of the 7 bits may be determined. However, consider the case where the non-puncture period is simple (one surviving parity bit per period) and the same as the period of the recursive encoding block, 7. Then every observation for $t > 6$ is the sum of the same subset of the 7 bits and so no new information is obtained, i.e., a rank-1 system of equations is formed and a unique solution does not exist. This is due to the periodic nature of the signal. When the non-puncture period is relatively prime with the period of the recursive encoding block, a series of observations of the parity bits will eventually form a rank-7 system of equations. For our 7-bit group, this is sufficient to uniquely determine the bits, i.e., information sufficient to determine the bits are distributed across the surviving parity bits. When the periods are not relatively prime, the rank of the system becomes L/K where L is the period of the recursive encoding block and K is the Greatest Common Divider (GCD) of L and N where N is the period of the non-puncture pattern.

[0021] In the above illustration, a long sequence of zeros after the small group of bits was supposed for clarity sake. However, allowing additional groups of bits to follow the first group does not add to the distributed information about earlier groups. This can be seen from the causality of the system.

[0022] It is also possible that some distributed information is lost even for non-simple periods, e.g., consider the case where the non-puncture pattern alternates between a simple period of three and four. This results in a period 7 non-puncture pattern but with two surviving parity bits per period. The same argument above leads

to a rank-2 system of seven equations which is still insufficient to uniquely determine the group of bits, but does reduce the dimension of the space they may span. Clearly, some information about the small group of bits is lost for some non-punctured patterns.

[0023] In order to obtain adequate performance, it is necessary to detect, avoid and/or correct the problematic puncturing patterns in the parity bit streams without having to avoid code rates. Typically, problematic interactions occur between the Turbo coder output and puncturing in the rate matching stages.

[0024] It would be desirable to have a method for creating high-rate Turbo codes that avoids problematic interactions by modifying the puncturing patterns.

SUMMARY OF THE INVENTION

[0025] According to the present invention, degradations in quality of punctured error correction coded transmissions are identified and the code transmissions are modified accordingly. A puncturing pattern which approximates a particular code rate is identified, and a value for anticipated degradation is adjusted in accordance with a matching of the puncturing pattern and the particular code rate.

[0026] For both FDD and TDD, two stages of rate matching and two puncturing operations are included, and this is done because of a certain technique called, incremental redundancy, which allows for a wireless transmit/receive unit (WTRU) to receive and soft combine multiple transmissions of the same TB from the base station. If the transmission fails the first time, the signal is retransmitted with more data in an attempt to obtain a successful communication the second time. In order to do that, two different stages of puncturing are used because the WTRU has certain capabilities, certain buffer sizes that it can support, and in order to be able to fit the retransmissions that are combined into the buffer, there are two stages of puncturing. The first stage of rate matching punctures enough bits such that the surviving bits fit into a buffer, and the second stage of puncturing (or repetition) is to achieve the desired overall code rate. When the two stages of rate matching are combined, a plot of problematic regions of coding rate is a multidimensional plot. Thus, there are two

rates now involved, which are a rate in a first stage of puncturing and a rate in a second stage of puncturing.

[0027] According to a first embodiment of the present invention, P1/P2 puncturing biasing for a single stage of rate matching is implemented using the punctured error correction coded transmissions.

[0028] According to a second embodiment, two or more stages may be employed at each stage of rate matching for detecting and correcting performance in punctured Turbo codes on a High Speed Downlink Shared Channel (HS-DSCH) in R5 High Speed Downlink Packet Access (HSDPA).

BRIEF DESCRIPTION OF THE DRAWINGS

[0029] A more detailed understanding of the invention may be had from the following description of a preferred embodiment, to be understood in conjunction with the accompanying drawing wherein:

[0030] Figure 1 is a schematic diagram of a typical CDMA system in accordance with current 3GPP specifications;

[0031] Figure 2 is a processing diagram of TrCH data for a CCTrCH in accordance with 3GPP TDD specifications;

[0032] Figures 3 and 4 are diagrams of channel coding and multiplexing examples in accordance with 3GPP TDD specifications;

[0033] Figures 5A, 5B and 6 are diagrams of channel coding and multiplexing examples in accordance with 3GPP FDD specifications;

[0034] Figure 7 shows typical results of particular codes being created by puncturing, where as much as 4 dB loss can be measured in critical SNR value;

[0035] Figure 8 graphically depicts the SNR required to successfully decode a data block (critical SNR) with high probability vs. Code Rate when P1/P2 biasing is applied;

[0036] Figure 9 is a plot of the problematic regions with respect to an ordered pair (r1,r2) which are the rates of puncturing the parity streams in the first and second stages of rate matching, respectively;

[0037] Figure 10 is a schematic block diagram showing a circuit for 3GPP rate matching for HSDPA, using a Turbo coded HS-DSCH; and

[0038] Figure 11 graphically depicts initial Block Error Rate (BLER) for HS-DSCH transport blocks with certain effective coding rates.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

[0039] In accordance with the present invention, several methods and embodiments are disclosed for detecting, avoiding and/or correcting the problematic puncturing patterns in the parity bit streams without having to avoid code rates.

[0040] The present invention is potentially applicable to layers 1 and 2 in a FDD, CDMA 2000 and TDD Universal Mobile Telecommunications System (UMTS) modes of transmission as well as other modes of transmission. Additionally, methods are described hereinafter for modifying the puncturing patterns such that performance of degraded Turbo code is restored.

[0041] In accordance with the present invention, the methods disclosed herein may be implemented in a wireless transmit/receive unit (WTRU) and/or a base station. Hereinafter, a WTRU includes but is not limited to a UE, mobile station, fixed or mobile subscriber unit, pager, or any other type of device capable of operating in a wireless environment. When referred to hereafter, a base station includes but is not limited to a base station, Node-B, site controller, access point or other interfacing device in a wireless environment.

[0042] Figure 8 graphically depicts the SNR required to successfully decode a data block (critical SNR) with high probability versus Code Rate when biasing of parity bits P1/P2 is applied. As shown in Figure 7, it has been found that particular codes created by puncturing the rate 1/3 3GPP Turbo code exhibit poorer than expected performance, as can be seen from the peaks in the figure.

[0043] Figure 9 is a plot of the problematic regions with respect to an ordered pair (r_1, r_2) which are the rates of puncturing the parity streams in the first and second stages of rate matching, respectively. As can be seen, there are particular regions where the rates of puncturing of the parity streams are such that some combinations of rates are particularly problematic.

[0044] In one embodiment, puncture biasing for parity bits P1 and P2 is implemented for one stage rate matching. Figure 10 is a schematic block diagram showing circuitry 600 for 3GPP rate matching for HSDPA, using a Turbo coded HS-DSCH. The circuitry 600 implements a 3GPP rate-matching scheme for HSDPA. The circuitry 600 includes a bit separation circuit 605, a first rate matching stage 610, a virtual incremental redundancy (IR) buffer 615, a second rate matching stage 620 and a bit collection circuit 625. The first rate matching stage 610 includes a Parity 1 (P1) bit rate matching circuit 630 and Parity 2 (P2) bit rate matching circuit 635. The second rate matching stage 620 includes a systematic bit rate matching circuit 640, a Parity 1 (P1) bit rate matching circuit 645 for the second rate matching and a Parity 2 (P2) bit rate matching circuit 650 for the second rate matching. In operation, the systematic bits, Parity 1 (P1) and Parity 2 (P2) bits are processed through the first rate matching stage 610, virtual IR buffer 615, second rate matching stage 620 and bit collection circuit 625. Note that the Parity 1 (P1) and Parity 2 (P2) bits are treated separately. The systematic bits, Parity 1 (P1) and Parity 2 (P2) bits are combined at the bit collection circuit 625 to provide a single data output N_{data} . Also note that if the number of coded bits is less than or equal to the size of the virtual IR buffer 615, the first rate matching stage 610 is transparent. The transparent first stage case and Rel-4 rate matching are considered.

[0045] In its actual implementation, it is anticipated that the different circuit functions will be executed by a common circuit or circuits, such as microprocessor circuitry, and in accordance with program instructions. The specific circuit functions used to implement the invention would therefore be a matter of choice of those configuring the circuitry within the rate matching circuitry 600.

[0046] The rate matching algorithm performs puncturing if the overall code rate is greater than 1/3 and repetition if the code rate is less than 1/3. Currently code rates greater than 1/3 are accomplished by applying the same puncturing rate to both P1 and P2 bits (to within one bit) but with different puncturing pattern phases. In order to avoid non-puncturing periodicities that have been shown to degrade the Turbo code performance, the puncturing rates for P1 and P2 be independently biased. For example, if the number of P1 bits is decreased by Δ and the number of P2 bits is increased by Δ , the overall code rate is unchanged but the problematic non-puncturing periods can be avoided. Given this approach to avoiding the problematic code rates, an analytical expression for the requisite bias, has been derived.

[0047] A simple and efficient method of modifying the puncture patterns is biasing the number of punctured bits in P1 and P2 by adding additional puncturing to one and removing it from the other. The amount of the bias should be no more than is needed to avoid certain periodicities. In biasing the puncturing rates of P1 and P2 bits, two constraints must be met.

[0048] When non-puncturing patterns with period $7\hat{N}/2$ ($\hat{N} = 1, 2, 3\dots$) are used, degradation in performance results. These non-puncturing patterns will be employed whenever the average non-puncturing period of P1 or P2 bits is within ± 1 or $\pm 1/2$ of $7\hat{N}/2$ for even and odd $\hat{N}$ respectively.

[0049] The average non-puncturing rate of the P1 and P2 rate matching blocks is $I/(P/2)$ where I is the number of bits at the input to each branch of rate matching and P is the total number of parity bits (P1 and P2) at the output of rate matching. Therefore, the desired code rate will lead to a problematic puncturing pattern if,

$$\left| \frac{I}{(P/2)} - \frac{7\hat{N}}{2} \right| < 1 - \frac{\hat{N}}{2} + \left\lfloor \frac{\hat{N}}{2} \right\rfloor, \quad \text{Equation 1}$$

for $\hat{N} > 0$ where,

$$\hat{N} = \left\lfloor \frac{4I}{7P} + \frac{1}{2} \right\rfloor. \quad \text{Equation 2}$$

[0050] In biasing the puncturing rates of the parity bit streams 1 and 2, P1 and P2, two constraints must be met.

[0051] First, the number of surviving bits in parity bit stream 1 must be increased sufficiently by an amount Δ to avoid the problematic puncturing patterns. Second, the number of surviving bits in parity bit stream 2 must be decreased by an equal amount Δ that is also sufficient to avoid problematic puncturing patterns.

[0052] These two constraints can be combined in to the following expression for Δ , where:

$$[0053] \quad \Delta = \left\lceil \max \left\{ \left\lfloor \frac{I}{\frac{7\hat{N}-1}{2}} - \frac{P}{2} \right\rfloor, \left\lfloor \frac{P}{2} - \frac{I}{\frac{7\hat{N}+1}{2}} \right\rfloor \right\} \right\rceil \quad \text{Equation 3}$$

[0054] Alternatively, non-punctured bits may be increased in P2 and decreased in P1. The procedure to determine and apply the necessary P1/P2 bias is as follows:

Step 1) Compute $\hat{N}$ using Equation 2.

Step 2) Determine if the desired code rate results in a problematic puncturing pattern using Equation 1. If it does, continue to Step 3,

otherwise set $\Delta = 0$ (if $\left| \frac{I}{(P/2)} - \frac{7\hat{N}}{2} \right| \geq 1 - \frac{\hat{N}}{2} + \left\lfloor \frac{\hat{N}}{2} \right\rfloor$).

Step 3) Compute the bias Δ using Equation 3.

Step 4) Compute rate matching parameters by modifying Table in TS25.212/222.

[0055] In order to avoid puncturing patterns that degrade Turbo code performance, the amount of puncturing applied to parity bit streams 1 and 2 respectively could be slightly different, while keeping the overall number of punctured bits constant.

[0056] If the number of punctured bits in parity bit stream 1 is decreased by Δ and accordingly, the number punctured bits in parity bit stream 2 bits is increased by Δ , the overall code rate is unchanged, but the problematic puncturing patterns can be avoided. Note that bit collection and bit de-collection stages need to be adjusted correspondingly for this case. Since individual regions of degraded performance tend to be small, it may be advantageous to simply avoid the use of code rates with degraded performance. Since code rates with degraded performance can now be identified using the above equation, it is a simple matter to avoid them.

[0057] For Hybrid Automatic Repeat reQuest (HARQ) as deployed in 3GPP, it may be necessary to employ two stages of rate matching. This occurs whenever incremental redundancy (IR) is employed and the number of bits input to the rate-matching algorithm is larger than the virtual IR buffer. Note that when Chase combining HARQ is used, there is no need for a special IR buffer; a received bit buffer would be sufficient. (If constellation rearrangement were not used, a buffer of received symbols would be sufficient.) If it is determined that IR provides only a small improvement over Chase combining, then removal of IR from the standards may be advisable.

[0058] In order to obtain higher data rates, the 3GPP has introduced the HSDPA option wherein link adaptation is performed. One component of the link adaptation is Adaptive Modulation and Coding (AMC). With AMC, a channel quality estimate is used to select the modulation type and code rate that attains the largest throughput. When the channel quality is high, QAM modulation and a high code rate are selected. High code rates are obtained by puncturing a rate 1/3 Turbo code. During the design of the channel quality indication (CQI) table, it was observed that certain Transport Block Set Sizes (TBSS) exhibited poorer than expected performance. The CQI table is used to map a channel quality estimate into a recommended modulation and TBSS. This problem of poorer than expected performance is currently addressed by simply "hand tweaking" the CQI table to avoid the TBSSs that cause problems. In AMC, this

leads to less than optimal throughput since optimal code rates will inevitably be avoided.

[0059] Support for link adaptation by means of AMC is an integral feature of R5 HSDPA. With AMC, modulation type and code rate on HS-DSCH can be varied according to channel conditions. Variable coding rates on HS-DSCH are achieved by means of rate matching (repetition or puncturing) output of the R99 Turbo-coder in a pre-determined manner, i.e. as a function of TBSS and available number of Physical Channel bits. Both R99/R4 and R5 use the same code rate 1/3 Turbo-coder. While the principle of rate-matching is the same for both R4 and R5, the likely and more frequent use of higher effective code rates ($>1/2$), the use of multiple stages of rate matching, and the standard allowing for the possibility of Incremental Redundancy (IR) differentiate R99/R4 and R5.

[0060] HSDPA performance requirements in WG4 have indicated unusually high and rather unpredictable SNR performance degradations for Turbo-coded and punctured transport blocks on HS-DSCH up to several dB for a range of effective coding rates above 1/2.

[0061] The Turbo-coding performance on HS-DSCH is heavily impacted by unfavorable puncturing patterns of the parity bit streams output by the baseline rate 1/3 Turbo-coder. Although the original WG4 simulation results were provided in a TDD-context, exactly the same degradations also occur in FDD, the reason being that Turbo-coding and rate-matching (TS25.212 and TS25.222) on HS-DSCH transport blocks (where the problematic interactions originate) are done exactly the same way for both modes.

[0062] The poorer than expected performance at some data rates is also a problem with a fixed modulation and coding scheme. If a user is assigned a code rate that exhibits the problem, the poor performance of the code will be compensated for by power control thus reducing cell capacity.

[0063] In another embodiment, adjustments to the parity stream puncturing allows the Medium Access Control – High Speed (MAC-hs) to simply select any desired

transport block size as an outcome of the scheduler decision. It would be required to slightly change the generation of the puncturing patterns in the rate-matching stages in TS25.212/222. For example, one implementing modification to the current FDD standard as set for in TS 25.212 is appended hereto along with a brief discussion of why the modification is desirable.

[0064] For both the case of 1st rate-matching stage being transparent and the case of both 1st and 2nd rate-matching stage being employed, a number of acceptable solutions exist to avoid the problematic interactions by means of adjustments to the parity bit puncturing.

[0065] One of these solutions, e.g. a simple biasing method, is outlined below in the interest of providing a conceptual example for the case of the 1st rate-matching stage being transparent.

[0066] Currently, coding rates $>1/3$ are accomplished by applying the same amount of puncturing to both parity bit streams 1 and 2 at the output W of the Turbo-coder (Figure 10), although the puncturing pattern “phases” can be adjusted.

[0067] When a particular code rate is desired and it is determined that its use will result in degraded performance, a slightly lower code rate may be selected to avoid the degradation. Good choice for the substituted code rate would be the largest allowable code rate less than the desired code rate that has been determined to have an acceptable degradation.

[0068] If it is desirable for a system to be allowed to make unrestricted use of available code rates, then performance may be restored by modification of the puncture pattern. The key to restoring performance to the punctured Turbo code is to avoid the case where the surviving parity bits are overly redundant with respect to the systematic bits, i.e., modify the puncturing pattern to improve performance. One way to accomplish this is to sample the parity bits such that all the points corresponding to one complete period of the semi-periodic impulse response are sampled with as few samples as possible while maintaining the same code rate and not overly distorting the

uniformity of the puncturing over the data block or creating overly large imbalances in the number of surviving parity bits in P1 and P2.

[0069] It should also be noted that this method of mitigation could also be applied to systems with more than 2 parity streams. For example, the 3GPP Turbo code (CDMA 2000) includes four parity streams. If a problematic puncturing pattern occurs it can be alleviated by adjusting the puncturing rates of each of the individual parity streams while maintaining a constant overall effective coding rate.

[0070] In the case of single stage of rate matching, as used in R99/R4 and in many R5 configurations, the problematic interactions between the Turbo-coded output and the punctured transmitted sequence occurs in regions where the puncturing patterns are nearly periodic with surviving bit period equal to a multiple of 7, and when an average 1 out of every 3.5 parity bits survive.

[0071] These degradations correspond to rank-1 and rank-2 scenario respectively. This case corresponds to the rank-1 scenario. Rank-2 scenarios have less impact on the SNR degradation than rank-1 scenarios. Since higher rank scenarios (>2) do not significantly contribute to performance degradation, ranks other than rank-1 and rank-2 scenarios are not considered here.

[0072] The code rates at the center of these regions are determined by:

$$[0073] \quad CR = \frac{1}{1 + \frac{2}{3.5N}} = \frac{3.5N}{3.5N + 2} \quad N = 1, 2, \dots \quad \text{Equation 4}$$

[0074] The critical code rate, CR , corresponds to a rank-1 scenario when N is even and rank-2 when N is odd. For rank-1, we have critical code rates $CR = 7/9, 7/8, 21/23, \dots$ and for rank-2, we have $CR = 7/11, 21/25, \dots$

[0075] The ratio of the number of systematic bits and the number of parity bits in either parity bit stream 1 or 2 can be considered as “parity puncturing rate”. When surviving bit patterns with parity puncturing rate close or equal to $7N/2$ ($N=1,2,3,\dots$) are used, degradation in performance results. Some amount of Turbo-coding and puncturing interaction will also occur whenever the average periodicity of surviving

bits of the parity bit streams 1 or 2 is within ± 1 or $\pm \frac{1}{2}$ of $7N/2$ for even and odd N respectively.

[0076] When two (or more) stages of rate matching are employed, problematic puncturing patterns can be generated by any stage, or by the interaction between the stages of rate matching.

[0077] A closed form expression(s) has been developed for the Release 5 3GPP Turbo coder / Rate Matching that predicts the performance degradation. The expression takes as input either the triplet {Bits Before 1st stage of rate Matching, Max Bits after 1st Rate Matching, Bits after 2nd Rate matching} or the pair {Rate of 1st stage Rate Matching with respect to parity bits, Rate of 2nd stage Rate Matching with respect to parity bits}. The output, as depicted in Equation 5 below, is a rational number that may be compared to a threshold to accept/reject the configuration as providing/not providing acceptable performance. The parameters $r1$ and $r2$ represent the rates associated with the 1st and 2nd stages of rate matching with respect to the parity bit streams. Although complicated, the Equation 5 is a piecewise linear and continuous function in $r1$, $r2$ and is therefore trivial to evaluate.

$$\lambda(r1, r2) = \sum_{n=1}^{L-1} \alpha_n \left[\left(1 - \left\lceil \frac{1}{L} \lceil r1 \lceil nr2 \rceil \rceil - \left\lfloor \frac{1}{L} \lceil r1 \lceil nr2 \rceil \rceil \right\rfloor \right) (nr2 - \lfloor r2 \rfloor) (\lceil r1 \lceil nr2 \rceil \rceil - \lfloor r1 \lceil nr2 \rceil \rfloor) + \right. \\ \left. \left(1 - \left\lfloor \frac{1}{L} \lfloor r1 \lfloor nr2 \rfloor \rfloor - \left\lceil \frac{1}{L} \lfloor r1 \lfloor nr2 \rfloor \rfloor \right\rceil \right) (nr2 - \lfloor nr2 \rfloor) (-\lceil r1 \lfloor nr2 \rfloor \rceil - \lfloor r1 \lfloor nr2 \rfloor \rfloor + 1) + \right. \\ \left. \left(1 - \left\lceil \frac{1}{L} \lceil r1 \lfloor nr2 \rfloor \rceil - \left\lfloor \frac{1}{L} \lceil r1 \lfloor nr2 \rfloor \rceil \right\rfloor \right) (-nr2 + \lfloor nr2 \rfloor + 1) (\lceil r1 \lfloor nr2 \rfloor \rceil - \lfloor r1 \lfloor nr2 \rfloor \rfloor) + \right. \\ \left. \left(1 - \left\lfloor \frac{1}{L} \lfloor r1 \lfloor nr2 \rfloor \rfloor - \left\lceil \frac{1}{L} \lfloor r1 \lfloor nr2 \rfloor \rfloor \right\rceil \right) (-nr2 + \lfloor nr2 \rfloor + 1) (-\lceil r1 \lfloor nr2 \rfloor \rceil + \lfloor r1 \lfloor nr2 \rfloor \rfloor + 1) \right) \right] \quad \text{Equation 5}$$

[0078] A threshold comparison could then be based on this equation to test whether or not the Code Rate pair will perform adequately. Equivalently, the triple: {Data Block Size, Size After 1st Stage Rate-Matching, Size After 2nd Stage Rate-Matching} can be used since this triple maps directly into the Code Rate pair.

[0079] The effect of the periodicity of the puncturing pattern can also be mitigated by interleaving the parity bits before rate-matching occurs. In this way, after de-interleaving, periodic sampling of the parity bits is avoided even when periodic sampling is done in rate-matching.

[0080] The functionality of the channel interleaver can be incorporated into the rate-matching block interleaver. This can be accomplished by adding additional constraints to the rate-matching block interleaver (those defined by the channel interleaver) when the interleaver is designed. This however will require an additional interleaver for the systematic bits.

[0081] Note that the rearrangement of the non-punctured bits only needs to occur on a range equal to the period of the semi-periodic impulse response of the recursive encoding blocks of the Turbo encoder. Therefore, small time-varying interleavers can be added to the parity bit streams to prevent problematic puncturing patterns. This has the advantage of requiring less memory and helps to minimize the distortion of the uniformity of the puncturing.

[0082] Certain parameters may be made to vary as a function of time (or bit index) to generate puncturing patterns that will mitigate performance degradations. One such example for 3GPP includes modification of the rate-matching parameters X_i , e_{ini} , e_{minus} and e_{plus} parameters throughout the execution of the rate-matching. In this way, the parameters affecting the puncturing pattern may change at one or more locations within the block of bits being punctured. By allowing the parameters to change, the instantaneous code rates may be different from the desired overall code rate (thereby avoiding the puncturing interaction) while still maintaining the same overall code rate. For example: 1) e_{plus} and e_{minus} may change frequently throughout the puncturing algorithm thus breaking up any possible long runs of deleterious puncturing. 2) Parameters may be changed so that the code rate is changed so that it is higher in some portions of the code block and lower in others.

[0083] The above methods are examples of modifications to the puncturing pattern used to generate specific code rates. All such methods may be considered

special cases and specific implementations of the more general concept of a permutation of the puncturing pattern. Any method of changing the puncturing pattern, i.e., generating some permutation of the original puncturing pattern, has the potential of changing the overall performance of a code.

[0084] One can achieve the desired overall code rate while avoiding problematic puncturing patterns by adjusting the amount of puncturing performed in each stage. This method, when placed in the context of the 3GPP HSDPA Turbo Code / Rate Matching algorithm leads to artificially reducing the size of the virtual Incremental Redundancy (IR) buffer. In general the approach implies a modification to the individual puncturing rates of each of the stages such that a desirable overall puncturing pattern results.

[0085] Stage Rate Biasing is easily accomplished by changing the operating point (the $r1$, $r2$ pair) to some point on a curve of constant code rate (i.e., where the product $r1*r2$ is unchanged) where performance degradation is tolerable.

[0086] The combination of adjusting the stage puncturing rates as well as the relative rates of puncturing in the two parity streams can also mitigate the problematic interaction between the puncturing pattern and the Turbo Code performance.

[0087] This can be envisioned as splitting the operating point into two points. One of the points corresponds to the rates of 1st and 2nd stage rate matching for the first parity bit stream and the second point for the second parity bit stream. The two points should be selected so that the overall code rate is unchanged, both points lie in regions of acceptable performance, and the total number of surviving bits after the first stage of rate matching does not exceed imposed limits such as an IR buffer.

[0088] The present invention provides several simple and efficient techniques of detecting, avoiding and/or correcting problematic puncturing patterns in the parity bit streams without having to avoid desired code rates. According to the present invention, degradations in punctured error correction coded transmissions are reduced by identifying a puncturing pattern which approximates a particular code rate, and

adjusting a value for anticipated degradation in accordance with the matching of the puncturing pattern and the particular code rate.

[0089] When creating high rate codes via puncturing, it is generally desirable to distribute, as uniformly as possible, the bits that are punctured. Using this guideline, it is inevitable that certain code rates will require the resulting non-punctured bit pattern to be less effective. One such example occurs when the non-punctured bit pattern is periodic, with a period equal to the period of the semi-periodic impulse response of the recursive encoding blocks of the Turbo encoder. An algorithm may be used to identify all puncturing patterns with degraded performance.

[0090] In a particular embodiment of the invention, the capacity of a WTRU is determined, including buffer sizes that are supported by the WTRU. The puncturing is used to reduce the number of bits to fit into the buffer, and the overall code rate is adjusted so as to provide sufficient error correction capability. This provides a first rate in a first stage of puncturing and a second rate in a second stage of puncturing.

[0091] According to the present invention, detecting, avoiding and/or correcting problematic puncture patterns in parity bit streams and punctured Turbo codes is achieved without having to avoid desirable code rates. This is applicable without limitation, to FDD, TDD and other modes of transmission, and enables identification/avoidance of regions of relatively poor Turbo code performance, which might result from the prior art bit-puncturing scheme. The invention provides for forward error correction comprising Turbo coding and puncturing that achieve a smooth functional relationship between any measure of performance and the effective coding rate resulting from combining the lower rate code generated by the Turbo encoder with puncturing of the parity bits. Examples of measures of performance would be BLER, bit error rate (BER), required signal-to-interference ratio (SIR), or required SNR.

[0092] The patterns of the puncturing are created by creating an encoded transmission at a particular data rate and excluding some of the encoded bits. At the receiver end, zeros or other "filler" bits are put in place of the punctured bits, and the

decoding operation is based on the received signal with the missing bits. According to the present invention, the puncturing pattern is modified in order to eliminate degradation which would occur under particular puncturing patterns. In particular, if the puncturing pattern is regular or has a periodic nature, it is more likely to result in signal degradation. By eliminating the degradation, it is possible to achieve the desired code rate.

[0093] The present invention is particularly useful for 3GPP-coding, and can be used for low chip rate TDD, high chip rate TDD and FDD.

[0094] One such example of a periodicity occurs when the non-punctured bit pattern is periodic with period equal to the period of the semi-periodic impulse response of the recursive encoding blocks of the Turbo encoder. An algorithm is provided to identify all puncturing patterns with degraded performance. Additionally, modification of the puncturing patterns is performed such that performance of the Turbo code is restored.

[0095] Modifications to puncturing are used to restore Turbo performance. If it is desirable for a system to be allowed to make unrestricted use of available code rates, then performance may be restored by modification of the puncture pattern. Therefore if it is deemed desirable for a system to be allowed to make unrestricted use of available code rates, then performance may be restored by modification of the puncture pattern.

[0096] Adaptive coding means that on the fly, information is obtained from the WTRU that indicates the channel quality. Based on that, the transmitter adjusts its code rate amongst other parameters. In instances of poor reception, a substantial amount of redundancy is added, which results in a very low code rate, but which allows transfer of data through with the required block error probability.

[0097] The channel quality estimation procedure does not inherently take into account the possibility that problematic puncturing may have been used, nor should it. The channel quality is typically based on signal power and noise power, but it does not take into account the fact that the encoder may have been punctured in a problematic

way, therefore AMC will not serve to avoid problematic code rates. With good channel quality, very little coding is needed and it is possible to use a higher order modulation. If the channel quality is poor, the code rate is reduced. Therefore, a reduced data rate is used to provide the desired error performance. The channel quality indicator is used to monitor the channel quality and in turn provides input to the data rate controller.

[0098] Capacity is measured by determining a combined data rate to all users supported. If one or more users in a cell are tuned to a problematic code rate, then those users are presumed to require more power and thereby reduce capacity. In many cases the problematic coding rates are known or can be determined via this invention and therefore it is possible to avoid these rates.

[0099] The present invention provides an ability to identify problem rates in advance through some analytical means, and responding to this information by avoiding these rates either dynamically or statically. This can be achieved by detecting problematic patterns or by using a formula or table of rates to avoid. If a transmission calls for one of the problem rates, the actual transmission is provided at a rate which is slightly different. The result is, the problem rate is avoided.

[0100] These are representative examples of modifications to the puncturing pattern used to generate specific code rates, as applicable to layer 1 and layer 2 in the TDD and FDD mode of transmission in accordance with the present invention. Variations to the examples described are conceivable. All such variations may be considered special cases and specific implementations of the more general concept of a permutation of the puncturing pattern. Any method of changing the puncturing pattern, i.e., generating some permutation of the original puncturing pattern, has the potential of changing the overall performance of a code, and it is the intent to include permutations and methods of generating such permutations of the puncturing pattern envisaged in the present invention. All modifications and improvements to the basic concept of the invention as set forth hereinabove are envisaged to be within the ambit of the present invention.

[0101] Figure 11 shows the BLER performance of 3 different HS-DSCH transport blocks of increasing size 4554, 4705 and 4858 bits respectively. All of them are rate 1/3 Turbo-coded, and then punctured down to 6072 bits mapped to the High Speed Physical Downlink Shared Channels (HS-PDSCH). This results in an effective coding rate of 0.75 (labeled 7/9-), 0.77 (labeled 7/9) and 0.80 (labeled 7/9+) for the 3 increasing transport blocks sizes.

[0102] When increasing the effective coding rate (or equivalently increasing the puncturing rate) of a Turbo-coded transport block on HS-DSCH, one should expect that BLER performance degrades in a proportioned manner, i.e. gets increasingly worse for increasingly higher effective coding rates. This unfortunately does not always happen, and it can be seen in this example that the rate 0.77 (7/9) coded transport block needs some 3dB more SNR than a rate 0.80 coded transport block to achieve the same BLER of approximately 10%.

[0103] The reason for the observed degradations is that the periodicity (period = 7) in the output of the two Turbo-coder parity bit streams, as given by the impulse responses of the constituent recursive convolutional encoders, deleteriously interacts with the periodicity of the puncturing patterns applied by the second and/or the first rate matching stages in many cases. This effect is increasingly more frequent for increasingly higher puncturing rates.

[0104] In the analyses that follow, a single R99 rate-matching block is assumed. However, the concepts apply more generally to R4 and R5 with and without incremental redundancy. The main conclusion for both cases is that the critical puncturing rates leading to SNR degradation are predictable in principle, but would require a rather complex set of parameters to be taken into account.

[0105] The setting of critical puncturing rates is avoided in the MAC-hs in the Node B, which has the particular advantage that it would not require a change in current standards and could leave details open to vendor-specific implementation. While this approach is preferable, the look-up tables used are complex and restrictions on possible MAC-hs scheduler decisions are imposed.

[0106] Alternatively, slight modifications are made to the puncturing patterns as generated by the current rate-matching stages for HS-DSCH in TS25.212/222. These modifications constitute only a small change in the way the rate matching parameters are generated in TS25.212/222, e.g., parameters for HARQ second rate matching, and more importantly do not require any additional signaling.

[0107] Due to the apparent simplicity of the second option (slight modification of the generation of the puncturing pattern on Turbo-coded parity bit streams) and its transparency for the MAC-hs scheduler (simply selects whatever transport block size is desired as outcome of the scheduler decision), a corresponding change is made in TS25.212/222 to remedy this problem.

[0108] The constituent recursive convolutional encoders in the Turbo-coder as by TS25.212/222 have infinite impulse responses that are periodic with period 7 for positive time. The impact of certain patterns of surviving (i.e. non-punctured) bits in the parity bit stream can be qualitatively illustrated by considering how much information remains in these surviving parity bits.

[0109] The Turbo-coder produces 3 bit streams, systematic bits corresponding to the input sequence, parity bit stream 1 (output of 1st constituent encoder) and parity bit stream 2 (output of 2nd constituent encoder).

[0110] Note that the constituent recursive convolutional encoder is an LTI system on GF_2 . Therefore, the output of the encoder is a sum of shifted versions of the impulse response of the encoder. Each shifted version of the impulse response corresponds to the locations of the 1's in the TB.

[0111] Certain puncturing patterns may result in a loss of distributed information about a small group of bits across the set of bits in one of the parity bit streams. For example, let the TB consist of 7 bits followed by many zeros. Now consider the problem of trying to determine the seven bits by observation of the output of one encoder after heavy puncturing. Each observation made at the output is a sum of a subset of the 7 bits. The subset for each particular observation is determined by the surviving bit period and the impulse response of the recursive encoding block.

[0112] For most puncture patterns, sums over 7 different subsets of the 7 bits can eventually be observed. Therefore, a system of 7 equations with 7 unknowns can be formed. Assuming that they are linearly independent, the values of the 7 bits may be determined.

[0113] However, when the periodicity of surviving bits is simple (one surviving parity bit per period) and the same as the period of the recursive encoding block, 7, then, due to the periodicity of the signal, every observation for $t > 6$ is the sum of the same subset of the 7 bits and so no new information is obtained by subsequent observations. Thus, a rank-1 system of equations is formed and a unique solution does not exist.

[0114] When the periodicity of surviving bits is not a multiple of 7, making observations of the parity bits will eventually form a rank-7 system of equations after several observations. For our 7-bit group, this is sufficient to uniquely determine the bits, i.e. information sufficient to determine the bits is distributed across the surviving parity bits.

[0115] It is also possible that some distributed information is lost even for non-simple periods, e.g., consider the case where the non-puncture pattern alternates between a simple period of three and four (two surviving parity bits per period with period = 7).

[0116] This results in a period 7 non-puncture pattern but with two surviving parity bits per period. The same argument above leads to a rank-2 system of seven equations. This is still insufficient to uniquely determine the group of bits, but does reduce the dimension of the space they may span. Clearly, some information about the TB may also be lost for non-simple surviving bit patterns.

[0117] At least two alternative approaches exist to avoid the problematic interactions between Turbo-coder output and puncturing in the rate-matching stages.

[0118] The avoidance of problematic puncturing patterns is an approach that requires the MAC-hs to avoid using puncturing patterns that lead to SNR degradation

and does not use certain combinations for mapping incoming transport blocks sizes to HS-PDSCHs.

[0119] Avoidance would either require building lookup tables that identify the problematical configurations or evaluating the predicted degradation expression described previously in the MAC-hs scheduler.

[0120] An advantage of the look-up table approach is that no change in current standards would be required and that any particular implementation could be left vendor-specific.

[0121] A disadvantage of the avoidance approach is that it is complicated by the fact that there are several dimensions to the problem that will all play a role in determining if a particular configuration will give rise to degradation. Parameters the MAC-hs scheduler would need to take into account in addition include:

- (1) transport block set size of HS-DSCH transmission;
- (2) number of soft information bits to be stored at the WTRU for HARQ; and
- (3) number of physical channel bits allocated for the HS-PDSCHs.

[0122] For FDD, these parameters are implied by the combination indicator for number of channelization codes and modulation format i ($1 < i < 29$), and the transport block size k_i , ($0 < k_i < 62$) in TS25.321.

[0123] Described below is one embodiment of the present invention that includes a combination of previously described techniques.

[0124] The hybrid ARQ functionality matches the number of bits at the output of the channel coder to the total number of bits of the HS-PDSCH set to which the HS-DSCH is mapped. The hybrid ARQ functionality is controlled by the redundancy version (RV) parameters. The exact set of bits at the output of the hybrid ARQ functionality depends on the number of input bits, the number of output bits, and the RV parameters.

[0125] The hybrid ARQ functionality consists of two rate-matching stages and a virtual buffer.

[0126] The first rate matching stage matches the number of input bits to the virtual IR buffer, information about which is provided by higher layers. Note that, if the number of input bits does not exceed the virtual IR buffering capability, the first rate-matching stage is transparent.

[0127] The second rate matching stage matches the number of bits after first rate matching stage to the number of physical channel bits available in the HS-PDSCH set in the TTI.

[0128] Definitions of notations used:

N^{TTI} : Number of bits in a transmission time interval before rate matching.

ΔN_i : An intermediate calculation variable.

$\Delta N_{i,l}^{TTI}$: If positive - number of bits to be repeated in each transmission time interval on TrCH i with transport format l .

If negative - number of bits to be punctured in each transmission time interval on TrCH i with transport format l .

ΔN_{PARITY} : Number of bits to adjust the length of parity streams by, in HARQ 1st stage rate-matching.

N_{data} : Total number of bits that are available for the HS-DSCH in a TTI.

e_{ini} Initial value of variable e in the rate matching pattern determination algorithm.

e_{plus} Increment of variable e in the rate matching pattern determination algorithm.

e_{minus} Decrement of variable e in the rate matching pattern determination algorithm.

b : Indicates systematic and parity bits

$b=1$: Systematic bit, x_k .

$b=2$: 1st parity bit (from the upper Turbo constituent encoder), z_k .

$b=3$: 2nd parity bit (from the lower Turbo constituent encoder), z'_k .

[0129] The HARQ bit separation function shall be performed in the same way as bit separation for turbo encoded TrCHs.

[0130] HARQ first stage rate matching for the HS-DSCH transport channel shall be performed using the method described below with the following specific parameters.

[0131] The maximum number of soft bits available in the virtual IR buffer is N_{IR} which is signaled from higher layers for each HARQ process. The number of coded bits in a TTI before rate matching is N^{TTI} this is deduced from information signaled from higher layers and parameters signaled on the High Speed Synchronization Control Channel (HS-SCCH) for each TTI. Note that HARQ processing and physical layer storage occurs independently for each HARQ process currently active.

[0132] If N_{IR} is greater than or equal to N^{TTI} (i.e. all coded bits of the corresponding TTI can be stored) the first rate matching stage shall be transparent. This can, for example, be achieved by setting $e_{minus} = 0$. Note that no repetition is performed.

[0133] If N_{IR} is smaller than N^{TTI} the parity bit streams are punctured by setting the rate matching parameter $\Delta N_{il}^{TTI} = N_{IR} - N^{TTI}$ where the subscripts i and l refer to transport channel and transport format in the referenced sub-clause. Note the negative value is expected when the rate matching implements puncturing. Bits selected for puncturing which appear as δ shall be discarded and not counted in the totals for the streams through the virtual IR buffer.

[0134] If first stage puncturing is to be performed, the procedure below shall be applied. Index b is used to indicate systematic ($b=1$), 1st parity ($b=2$), and 2nd parity bit ($b=3$). The parameter ΔN_{PARITY} is the change in length to the parity streams to circumvent problematic puncturing rates.

The first stage rate matching delta is calculated as follows:

if puncturing is to be performed

$$X_i = \lfloor N^{TTI} / 3 \rfloor; \quad PR = \frac{\lfloor -\Delta N_{il}^{TTI} / 2 \rfloor}{X_i}; \quad \Delta N_{PARITY} = 0; \quad \delta_{PR} = 49; \quad \alpha = 1$$

while($\alpha \leq 4$)

$$round = \frac{\left\lfloor 7 \cdot \alpha \cdot PR + \frac{1}{2} \right\rfloor}{7 \cdot \alpha}$$

$$\lambda = PR - round$$

if $\left(|\lambda| > \frac{1}{\delta_{PR}} \right) \text{ or } \left(PR > \frac{48}{49} \right) \text{ or } \left(PR < \frac{1}{49} \right)$ then

$$\alpha = \alpha + 1$$

$$\delta_{PR} = 98$$

else if ($\lambda > 0$) then

$$\Delta N_{PARITY} = \left\lfloor \left\lfloor -\Delta N_{il}^{TTI} / 2 \right\rfloor - X_i \cdot \left(round - \frac{1}{\delta_{PR}} \right) \right\rfloor$$

$$\alpha = 5$$

else

$$\Delta N_{PARITY} = \left\lfloor \left\lfloor -\Delta N_{il}^{TTI} / 2 \right\rfloor - X_i \cdot \left(round + \frac{1}{\delta_{PR}} \right) \right\rfloor$$

$$\alpha = 5$$

end if

end while

$$\Delta N_i = \begin{cases} \left\lfloor -\Delta N_{il}^{TTI} / 2 \right\rfloor - \Delta N_{PARITY}, & b = 2 \\ \left\lceil -\Delta N_{il}^{TTI} / 2 \right\rceil + \Delta N_{PARITY}, & b = 3 \end{cases}$$

a = 2 when b=2

a = 1 when b=3

[0135] If ΔN_i is calculated as 0 for $b=2$ or $b=3$, then the following procedure and the rate matching algorithm shall not be performed for the corresponding parity bit stream.

[0136] For each radio frame, the rate-matching pattern shall be calculated, where:

X_i is as above,

$$e_{ini} = X_i$$

$$e_{plus} = a \times X_i$$

$$e_{minus} = a \times |\Delta N_i|$$

[0137] HARQ second stage rate matching for the HS-DSCH transport channel shall be done using one of two possible methods.

[0138] If second stage puncturing is to be performed, and the Composite Puncturing Rate of one of the parity streams, calculated using the formula below falls in any of the intervals [91/128, 92/128], [217/256, 222/256], [231/256, 232/256], [237/256, 238/256] or [487/512, 488/512], then puncturing of that parity stream shall be performed. Note, puncturing maybe carried out on one, both, or neither of the two parity streams, but never on the systematic parity stream.

$$[0139] \quad \text{Composite Puncturing Ratio, } CPR = \begin{cases} \frac{\lfloor N^{TTI} / 3 \rfloor - N_{t,p1}}{N^{TTI} / 3}, b = 2 \\ \frac{\lfloor N^{TTI} / 3 \rfloor - N_{t,p2}}{N^{TTI} / 3}, b = 3 \end{cases}$$

[0140] Otherwise, second stage rate matching for the HS-DSCH transport channel shall be done with the following specific parameters. Bits selected for puncturing which appear as δ shall be discarded and are not counted in the streams towards the bit collection.

[0141] The parameters of the second rate matching stage depend on the value of the RV parameters s and r . The parameter s can take the value 0 or 1 to distinguish between transmissions that prioritize systematic bits ($s = 1$) and non systematic bits ($s = 0$). The parameter r (range 0 to $r_{max}-1$) changes the initial error variable e_{ini} in the

case of puncturing. In case of repetition both parameters r and s change the initial error variable e_{ini} . The parameters X_i , e_{plus} and e_{minus} are calculated as per table 1 below.

[0142] Denote the number of bits before second rate matching as N_{sys} for the systematic bits, N_{p1} for the parity 1 bits, and N_{p2} for the parity 2 bits, respectively. Denote the number of physical channels used for the HS-DSCH by P . N_{data} is the number of bits available to the HS-DSCH in one TTI and defined as $N_{data}=P \times 3 \times N_{data1}$. The rate matching parameters are determined as follows.

[0143] For $N_{data} \leq N_{sys} + N_{p1} + N_{p2}$, puncturing is performed in the second rate matching stage. The number of transmitted systematic bits in a transmission is $N_{t,sys} = \min\{N_{sys}, N_{data}\}$ for a transmission that prioritizes systematic bits and $N_{t,sys} = \max\{N_{data} - (N_{p1} + N_{p2}), 0\}$ for a transmission that prioritizes non systematic bits.

[0144] For $N_{data} > N_{sys} + N_{p1} + N_{p2}$ repetition is performed in the second rate matching stage. A similar repetition rate in all bit streams is achieved by setting the number of transmitted systematic bits to $N_{t,sys} = \left\lfloor N_{sys} \cdot \frac{N_{data}}{N_{sys} + 2N_{p1}} \right\rfloor$.

[0145] The number of parity bits in a transmission is:
 $N_{t,p1} = \max\left(\left\lfloor \frac{N_{data} - N_{t,sys}}{2} \right\rfloor - \Delta N_{PARITY}, 0\right)$ and $N_{t,p2} = N_{data} - (N_{t,sys} + N_{t,p1})$ for the parity 1 and parity 2 bits, respectively.

	X_i	e_{plus}	e_{minus}
Systematic RM S	N_{sys}	N_{sys}	$ N_{sys} - N_{t,sys} $
Parity 1 RM P1_2	N_{p1}	$2 \cdot N_{p1}$	$2 \cdot N_{p1} - N_{t,p1} $
Parity 2 RM P2_2	N_{p2}	N_{p2}	$ N_{p2} - N_{t,p2} $

Table 1: Parameters for HARQ second rate matching

[0146] Table 1 above summarizes the resulting parameter choice for the second rate matching stage. The rate matching parameter e_{ini} is calculated for each bit stream according to the RV parameters r and s using

$$e_{ini}(r) = \left\{ \left(X_i - \left\lfloor r \cdot e_{plus} / r_{max} \right\rfloor - 1 \right) \bmod e_{plus} \right\} + 1 \text{ in the case of puncturing ,}$$

i.e., $N_{data} \leq N_{sys} + N_{p1} + N_{p2}$, and

$$e_{ini}(r) = \left\{ \left(X_i - \left\lfloor (s + 2 \cdot r) \cdot e_{plus} / (2 \cdot r_{max}) \right\rfloor - 1 \right) \bmod e_{plus} \right\} + 1 \quad \text{for repetition, i.e.,}$$

$N_{data} > N_{sys} + N_{p1} + N_{p2}$. Where $r \in \{0, 1, \dots, r_{max} - 1\}$ and r_{max} is the total number of redundancy versions allowed by varying r . Note that r_{max} varies depending on the modulation mode, i.e. for 16QAM $r_{max} = 2$ and for QPSK $r_{max} = 4$.

[0147] Note: For the modulo operation the following clarification is used: the value of $(x \bmod y)$ is strictly in the range of 0 to $y-1$ (i.e. $-1 \bmod 10 = 9$).

[0148] HARQ second stage rate matching for the HS-DSCH transport channel shall be done with the method described below, which separates each stream into segments with specific parameters calculated below. Bits selected for puncturing which appear as δ shall be discarded and are not counted in the streams towards the bit collection.

[0149] The parity stream will be segmented into 3 segments, the first segment will be made up of the first X_{seg1} bits of the parity stream, the second segment will be made up of the next X_{seg2} bits, and the last segment will be made up of the remaining X_{seg3} bits.

[0150] The first segment is denoted by $x_{i,1}, x_{i,2}, \dots, x_{i,X_{seg1}}$

The second segment by $x_{i,X_{seg1}+1}, x_{i,X_{seg1}+2}, \dots, x_{i,X_{seg2}}$;

And the final segment by $x_{i,X_{seg1}+X_{seg2}+1}, x_{i,X_{seg1}+X_{seg2}+2}, \dots, x_{i,X_i}$

Where $X_{seg1} = 42 \cdot \lfloor X_i / 98 \rfloor$, $X_{seg2} = 56 \cdot \lfloor X_i / 98 \rfloor$, $X_{seg3} = X_i \bmod 98$

[0151] Note: If X_i is less than 98 only the third segment exists, and if X_i is a multiple of 98 then the third segment will be empty. For the case where a particular

segment is empty, then of course no puncturing is performed on that non-existent segment.

[0152] Additional parameters for HARQ Second Rate Matching Stage for problematic puncturing rates

[0153] Parameters P , N_{data} , N_{sys} , N_{p1} , N_{p2} , $N_{p,t1}$, and $N_{p,t2}$ are calculated, additional parameters are defined below.

[0154] Denote the number of parity 1 bits before second rate matching after segmentation as $N_{p1,seg1}$, $N_{p1,seg2}$, $N_{p1,seg3}$ for the parity 1 bits in the 1st, 2nd and 3rd segment respectively. Denote the number of parity 2 bits before second rate matching after segmentation as $N_{p2,seg1}$, $N_{p2,seg2}$, $N_{p2,seg3}$ for the parity 1 bits in the 1st, 2nd and 3rd segment respectively. The rate matching parameters are determined as follows.

[0155] For $N_{data} \leq N_{sys} + N_{p1} + N_{p2}$, puncturing is performed in the second rate matching stage.

[0156] The number of parity bits after segmentation is

$$N_{pb,seg1} = 42 \cdot \lfloor N_{pb} / 98 \rfloor$$

$$N_{pb,seg2} = 56 \cdot \lfloor N_{pb} / 98 \rfloor$$

$$N_{pb,seg3} = N_{pb} \bmod 98$$

[0157] The number of parity bits in each segment for parity 1 bits (b=2), and parity 2bits (b=3) is:

$$N_{t,pb,seg1} = \left\lfloor \frac{49 \cdot N_{t,pb} \cdot \lfloor N_{pb} / 98 \rfloor}{N_{pb}} + \frac{1}{2} \right\rfloor;$$

$$N_{t,pb,seg2} = \left\lfloor \frac{49 \cdot N_{t,pb} \cdot \lfloor N_{pb} / 98 \rfloor}{N_{pb}} + \frac{1}{2} \right\rfloor;$$

$$N_{t,pb,seg3} = N_{t,pb} - (N_{t,pb,seg1} + N_{t,pb,seg2})$$

[0158] The parameters X_i , e_{plus} and e_{minus} are calculated as per table 2 below.

Stream	Segment	X_i	e_{plus}	e_{minus}
Systematic RMS		N_{sys}	N_{sys}	$ N_{sys} - N_{t,sys} $
Parity 1 RM P1_2	1st	$N_{p1,seg1}$	$2 \cdot N_{p1,seg1}$	$2 \cdot N_{p1,seg1} - N_{t,p1,seg1} $
	2nd	$N_{p1,seg2}$	$2 \cdot N_{p1,seg2}$	$2 \cdot N_{p1,seg2} - N_{t,p1,seg2} $
	3rd	$N_{p1,seg3}$	$2 \cdot N_{p1,seg3}$	$2 \cdot N_{p1,seg3} - N_{t,p1,seg3} $
Parity 2 RM P2_2	1st	$N_{p2,seg1}$	$N_{p2,seg1}$	$ N_{p2,seg1} - N_{t,p2,seg1} $
	2nd	$N_{p2,seg2}$	$N_{p2,seg2}$	$ N_{p2,seg2} - N_{t,p2,seg2} $
	3rd	$N_{p2,seg3}$	$N_{p2,seg3}$	$ N_{p2,seg3} - N_{t,p2,seg3} $

Table 2: Parameters for dithered HARQ second rate matching

[0159] The rate matching parameter e_{ini} is calculated for each segment of bit stream according to the RV parameters r and s using $e_{ini}(r) = \{(X_i - \lfloor r \cdot e_{plus} / r_{max} \rfloor - 1) \bmod e_{plus}\} + 1$ in the case of puncturing. Where $r \in \{0, 1, \dots, r_{max} - 1\}$ and r_{max} is the total number of redundancy versions allowed by varying r . Note that r_{max} varies depending on the modulation mode, i.e. for 16QAM $r_{max} = 2$ and for QPSK $r_{max} = 4$.

[0160] Note: For the modulo operation the following clarification is used: the value of $(x \bmod y)$ is strictly in the range of 0 to $y-1$ (i.e. $-1 \bmod 10 = 9$). The rate matching algorithm is called for each segment of the parity stream in turn.

[0161] For both parity streams, after the rate matching algorithm has been called for each of the three segments, the three punctured segments should be concatenated together in their original order.

[0162] The re-concatenated bit stream is denoted by:

$$x_{o,seg1,1}, x_{o,seg1,2}, \dots, x_{o,seg1,N_{t,p1,seg1}}, x_{o,seg2,1}, x_{o,seg2,2}, \dots, x_{o,seg2,N_{t,p1,seg2}}, x_{o,seg3,1}, x_{o,seg3,2}, \dots, x_{o,seg3,N_{t,p1,seg3}}$$

[0163] The HARQ bit collection is achieved using a rectangular interleaver of size $N_{row} \times N_{col}$. The number of rows and columns are determined from:

$$N_{row} = 4 \text{ for 16QAM and } N_{row} = 2 \text{ for QPSK}$$

$$N_{col} = N_{data} / N_{row}$$

where N_{data} is used.

[0164] Data is written into the interleaver column by column, and read out of the interleaver column by column starting from the first column.

[0165] $N_{t,sys}$ is the number of transmitted systematic bits. Intermediate values N_r and N_c are calculated using:

$$N_r = \left\lfloor \frac{N_{t,sys}}{N_{col}} \right\rfloor \text{ and } N_c = N_{t,sys} - N_r \cdot N_{col}.$$

[0166] If $N_c=0$ and $N_r > 0$, the systematic bits are written into rows $1 \dots N_r$.

[0167] Otherwise systematic bits are written into rows $1 \dots N_r+1$ in the first N_c columns and, if $N_r > 0$, also into rows $1 \dots N_r$ in the remaining $N_{col}-N_c$ columns.

[0168] The remaining space is filled with parity bits. The parity bits are written column wise into the remaining rows of the respective columns. Parity 1 and 2 bits are written in alternating order, starting with a parity 2 bit in the first available column with the lowest index number. If the two parity streams are of unequal length, Parity 1 and 2 bits shall be written alternately, again starting with a parity 2 bit, until the end of the shorter parity stream, then the remaining parity bits from the longer stream shall be written.

[0169] In the case of 16QAM for each column the bits are read out of the interleaver in the order row 1, row 2, row 3, row 4. In the case of QPSK for each column the bits are read out of the interleaver in the order row1, row2.

[0170] When the analysis of the rate matching issue was restricted to the situation in which the first stage HS-DSCH rate matching is transparent it was shown that the performance degradation arises from an interaction between the periodicity of the rate matching pattern and the inherent periodicity of the turbo encoder. In

particular, it was shown that at the problematic code rates, the positions (in the unpunctured bit stream) of survivor (i.e. non punctured) bits lie in the same position or positions within a modulo 7 period for long segments of the unpunctured stream. It has been demonstrated that performance degradations arise via exactly the same mechanism when the first stage is not transparent.

[0171] In the following description, a “puncturing pattern” is defined to be the pattern of positions of bits that are punctured from an original stream. “Puncturing Rate” is defined to be the reciprocal of the number of bits between punctured bit positions (inclusive of the punctured positions) in the original bit stream.

[0172] In the case of two-stage rate matching, puncturing that leads to degradation may occur in two ways:

- 1) A pattern arising from bits punctured in the first stage only
- 2) A pattern arising from bits punctured after the second stage; this pattern is dependent upon both the first and second rate matching stages.

[0173] In order to avoid either of these puncturing mechanisms that cause a performance degradation, the following methodology has been adopted:

[0174] In the first stage, test whether the puncturing will cause a problematic puncturing pattern. This is achieved by evaluating an “implicit duration” function, which predicts the length of periodicity in the puncturing pattern. The first stage rate matching is only adjusted if the calculated implicit duration indicates a necessity. In this case, the amount of bits punctured in the first parity stream is increased slightly, whilst in the second stream the number is correspondingly decreased slightly. This has the effect of shifting the puncturing rates in both streams to break up modulo 7 periodicity, whilst keeping the total amount of punctured bits the same. The adjustment in the puncturing rate in each of the streams is kept sufficiently small to leave the coding performance in each stream unaffected.

[0175] In the second stage, a composite puncturing rate for each stream, taking into account adjustments to the puncturing rate carried out at the first stage is calculated. The composite puncturing rate in each stream is compared with a look up

table, which predicts rates at which modulo-7 periodic patterns, and hence coding degradations will arise. If the composite rate of a stream falls within a range of problematic rates, a “dithering” algorithm is applied.

[0176] Differing puncturing rates are applied in the two parity streams if the puncturing pattern in the first stage will lead to a performance degradation, or is likely to contribute to an unwanted pattern after second stage rate matching. In this case, the number of bits punctured in the first parity stream is reduced by an amount ΔN_{PARITY} , whilst the number of bits punctured in the second stream is increased by the same amount. The decision as to whether such a change should take place is based upon a calculated parameter, which estimates the inverse of the length of runs of survivor bits which hold the same modulo 7 position in the unpunctured stream. This length becomes greater than 49 bits (i.e. 7 modulo 7 periods), then the adjustment to the lengths of the streams is applied.

[0177] The dithered puncturing algorithm may be applied to either or both of the two parity streams in the second stage. When processing a parity stream, the algorithm employs two puncturing rates, one higher than the original, and one lower, it then switches between these two puncturing rates whilst applying puncturing to the parity bit stream. The total number of bits punctured is kept the same as it would have been with the original algorithm. Generically it is possible to have one or many switching points between the two puncturing rates within a parity stream. The number of points is not critical to the performance, since the fraction of the bit stream punctured at each rate is independent of the number of switching points.

[0178] The number of switching points is set to one (or two), meaning that the punctured stream consists of two (or three) segments in which the first segment uses a lower puncturing rate than the original, the second uses a higher puncturing rate. If the two segments do not account for the whole of the parity stream, a third segment is allowed at the end that is punctured at the original rate. The third segment is kept short, and allows for puncturing exactly the correct amount of bits to maintain the overall puncturing rate. By breaking the parity stream into a low number of segments

in this way, the original rate matching algorithm can easily be used with some minor parameter changes.

[0179] The difference between the higher puncturing rate in the first segment and the original rate, and also between the lower puncturing rate in the second segment and the original has been set to 1/49. This selection allows for problematic rates to be avoided in all cases whilst not representing a significant change in coding rate.

[0180] In the majority of cases, the modified rate matching algorithm operates in exactly the same manner as previously defined. In the minority of cases in which either the first or second stage rate matching would lead to a performance degradation, unequal length streams and/or dithering are applied. Both of these modifications do not change the body of the rate matching procedure in any way, but rather the rate matching parameters that are applied. Furthermore, in an implementation, the modifications can be achieved with a modification to the Rate Matching DSP software without affecting any other part of the system.

[0181] The foregoing is a description of a preferred embodiment and alternative solutions to providing detecting, avoiding/correcting problematic Turbo code puncturing patterns. While this invention has been particularly shown and described with reference to preferred embodiments, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the scope of the invention as described hereinabove.

* * *

CLAIMS

What is claimed is:

1. An apparatus for use in wireless communications comprising:
a first interleaver configured to interleave systematic bits;
a second interleaver configured to interleave a first parity bit stream;
a third interleaver configured to interleave a second parity bit stream;
a buffer configured to buffer the interleaved systematic bits, the interleaved first parity bit stream and the interleaved second parity bit stream; and
a rate matching unit configured to select bits for transmission based on a plurality of redundancy versions; wherein at least one redundancy version of the set selects systematic bits over first and second parity bits and at least one redundancy version of the set selects first and second parity bits over systematic bits.
2. The apparatus of claim 1 wherein selecting of bits by the rate matching unit in response to a selected redundancy version changes in response to a location of the bits in the buffer.
3. A method for use in an apparatus of a wireless communications comprising:
interleaving, by the apparatus, systematic bits;
interleaving, by the apparatus, a first parity bit stream;
interleaving, by the apparatus, a second parity bit stream;
buffering, by the apparatus, the interleaved systematic bits, the interleaved first parity bit stream and the interleaved second parity bit stream; and
selecting, by the apparatus, bits for transmission based on a plurality of redundancy versions; wherein at least one redundancy version of the set selects systematic bits over first and second parity bits and at least one redundancy version of the set selects first and second parity bits over systematic bits.

4. The method of claim 3 wherein the selecting of bits for transmission in response to a selected redundancy version changes in response to a location of the bits in the buffer.

5. A wireless transmit/receive unit comprising:
circuitry configured to interleave systematic bits;
circuitry is further configured to interleave a first parity bit stream;
circuitry is further configured to interleave a second parity bit stream;
circuitry is further configured to buffer the interleaved systematic bits, the interleaved first parity bit stream and the interleaved second parity bit stream; and
circuitry is further configured to select bits for transmission based on a plurality of redundancy versions; wherein at least one redundancy version of the set selects systematic bits over first and second parity bits and at least one redundancy version of the set selects first and second parity bits over systematic bits.

6. The wireless transmit/receive unit of claim 5 wherein selecting of bits based on a selected redundancy version changes in response to a location of the bits in the buffer.

ABSTRACT

Detecting, avoiding and/or correcting problematic puncturing patterns in parity bit streams used when implementing punctured Turbo codes is achieved without having to avoid desirable code rates. This enables identification/avoidance of regions of relatively poor Turbo code performance. Forward error correction comprising Turbo coding and puncturing achieves a smooth functional relationship between any measure of performance and the effective coding rate resulting from combining the lower rate code generated by the Turbo encoder with puncturing of the parity bits. In one embodiment, methods to correct/avoid degradations due to Turbo coding are implemented by puncturing interactions when two or more stages of rate matching are employed.

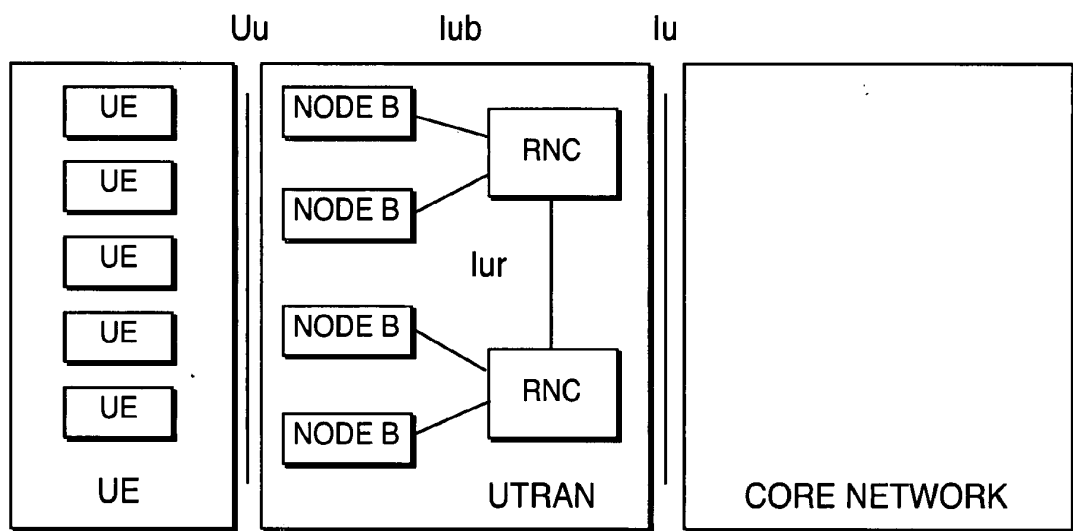


FIG. 1
PRIOR ART

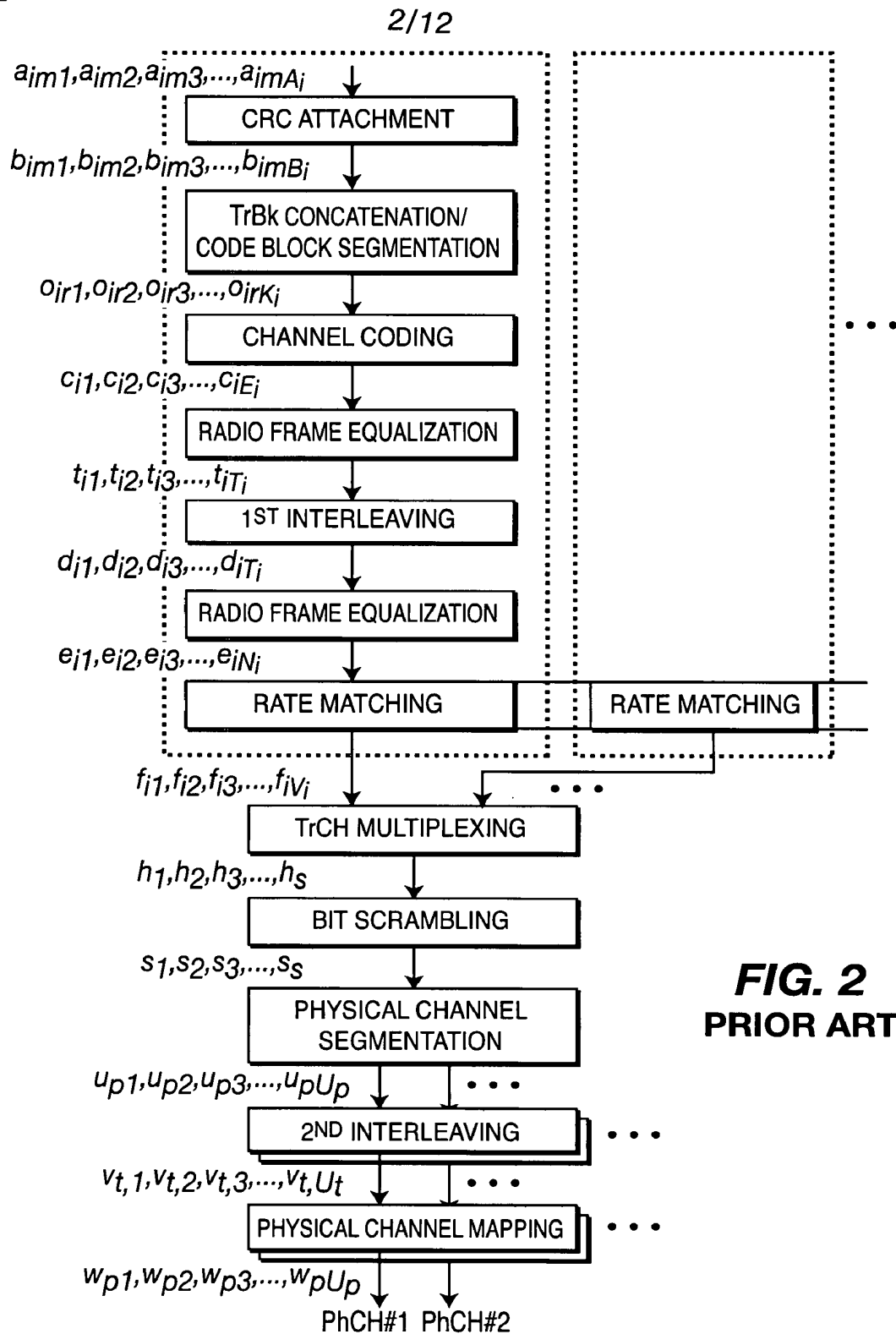


FIG. 2
PRIOR ART



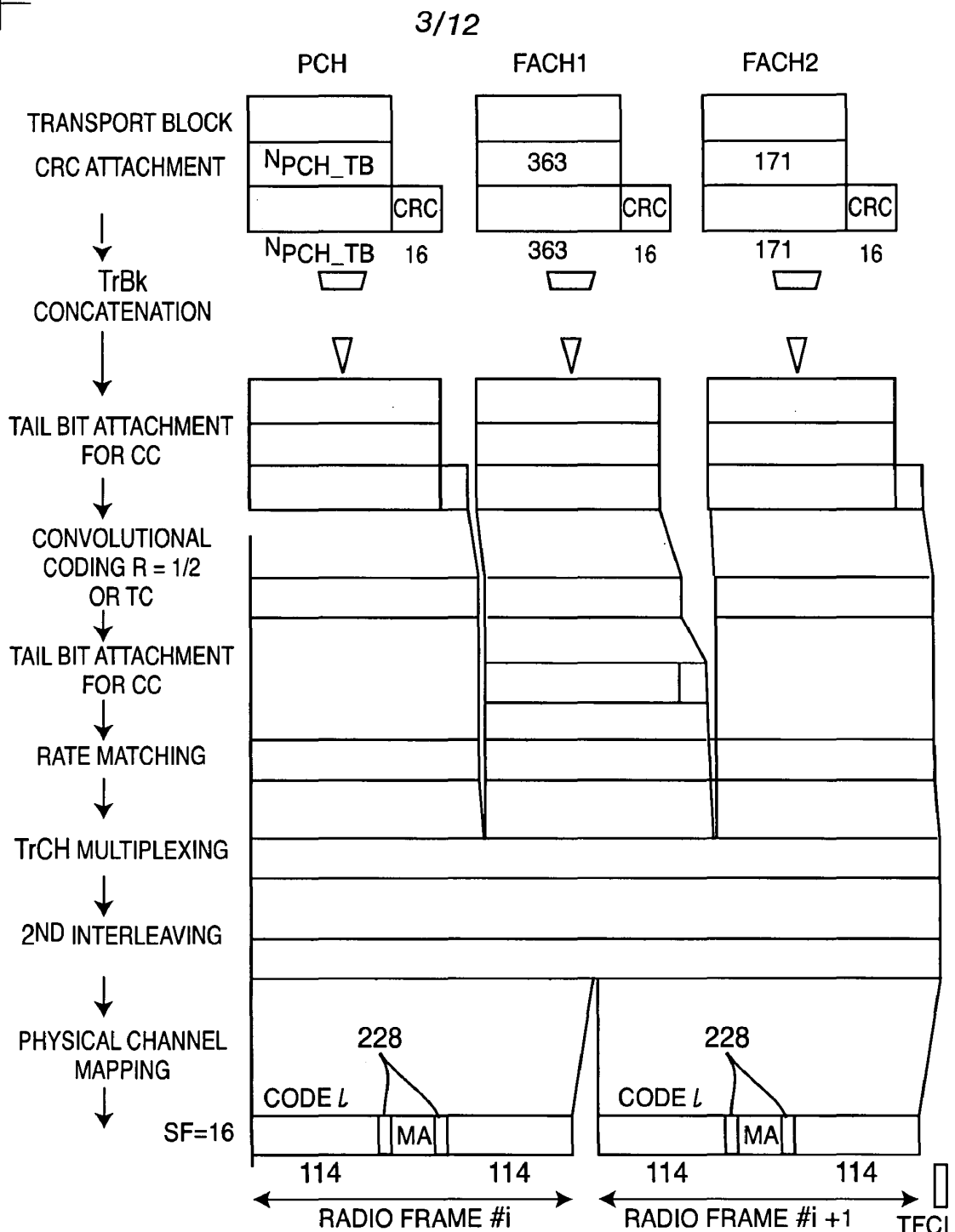


FIG. 3
PRIOR ART



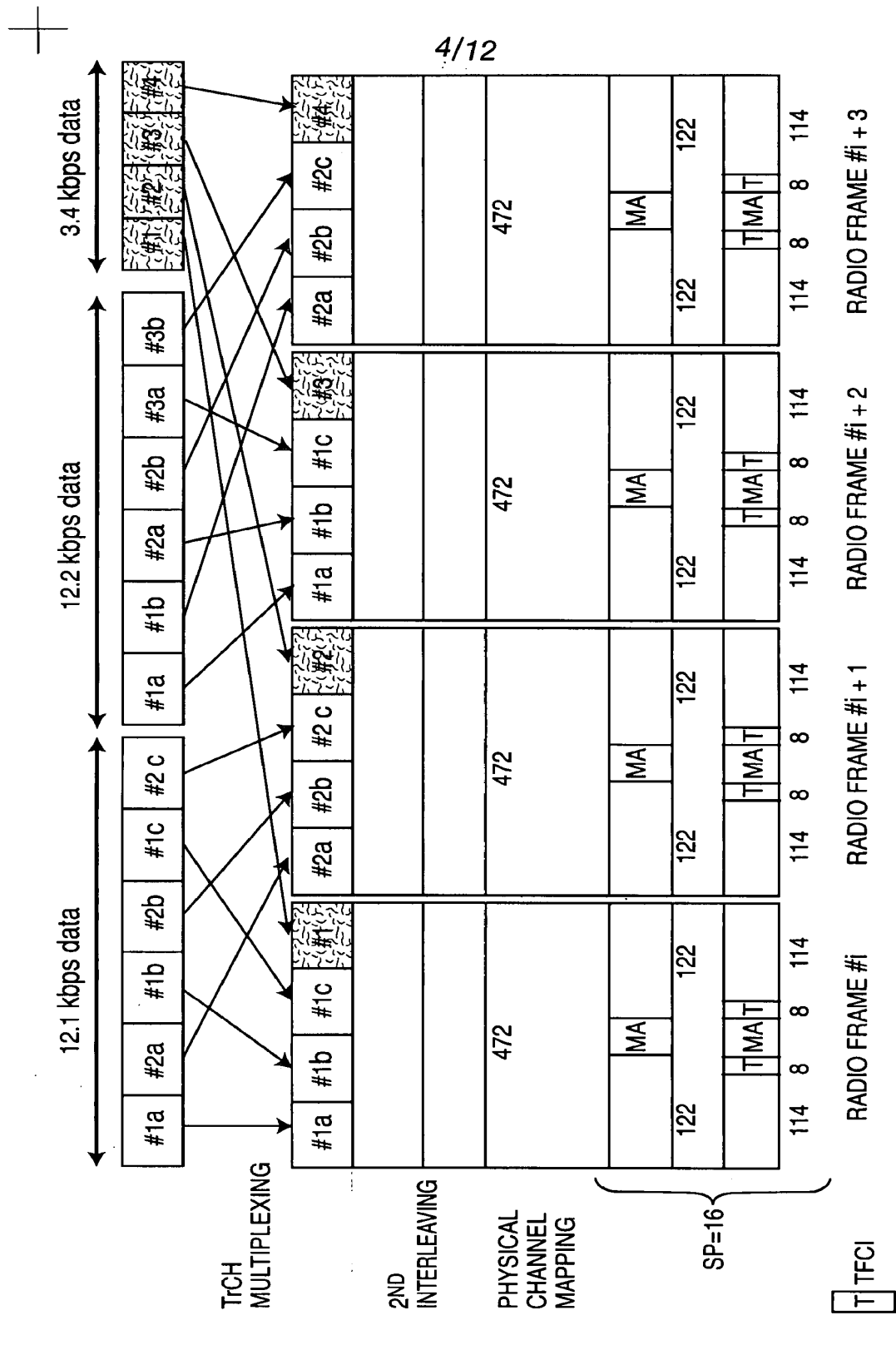
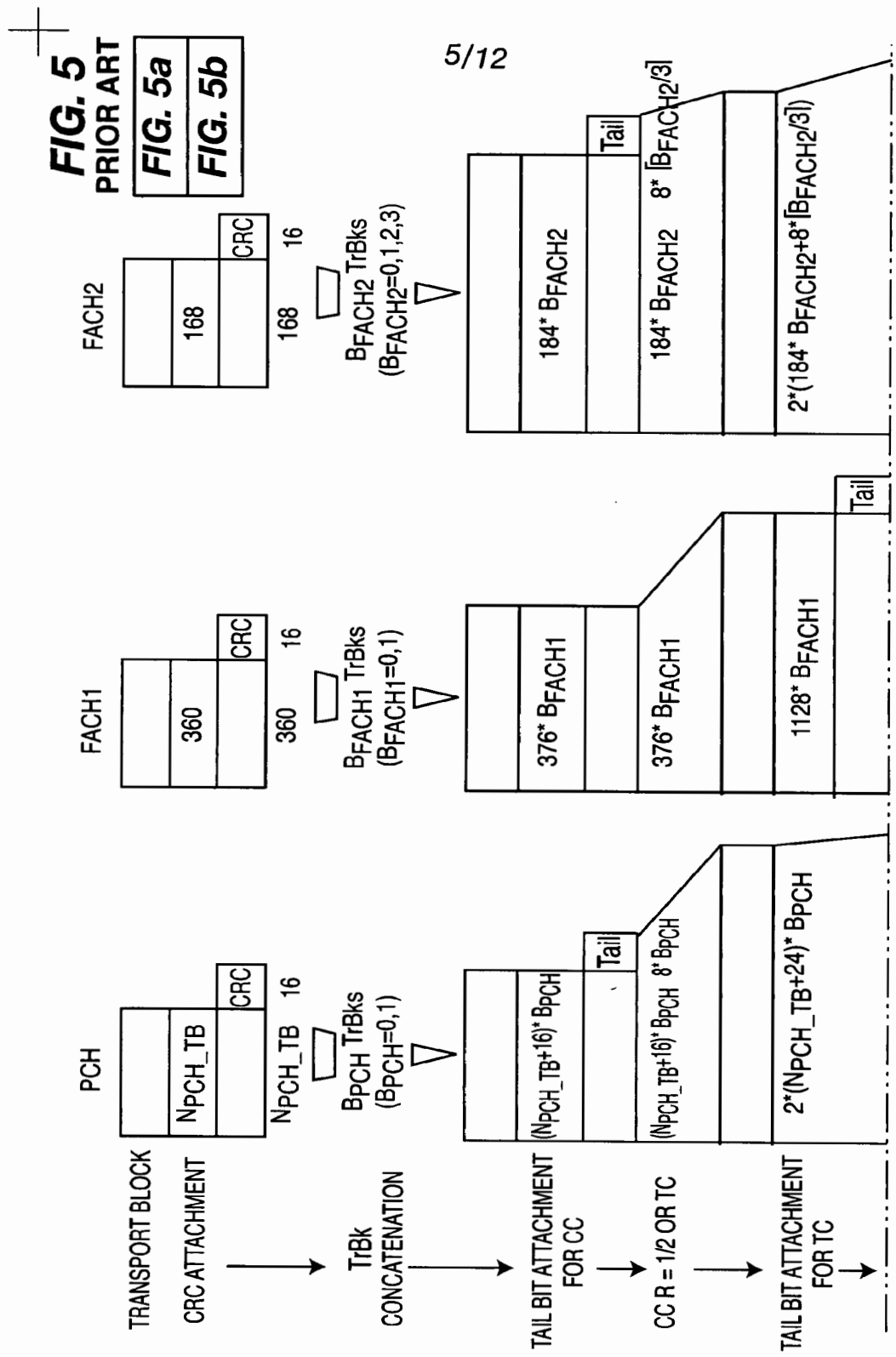


FIG. 4 PRIOR ART



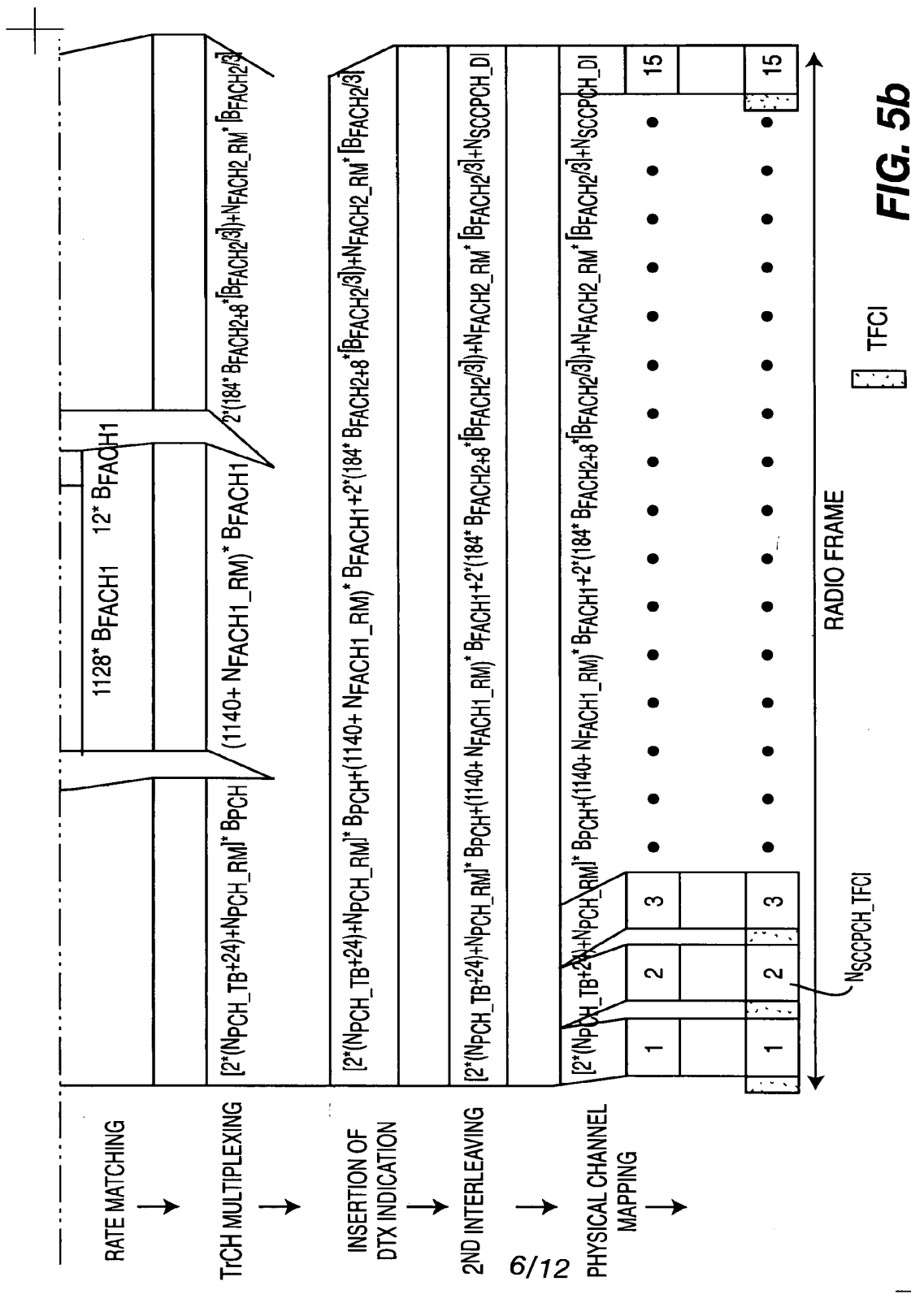


FIG. 5b

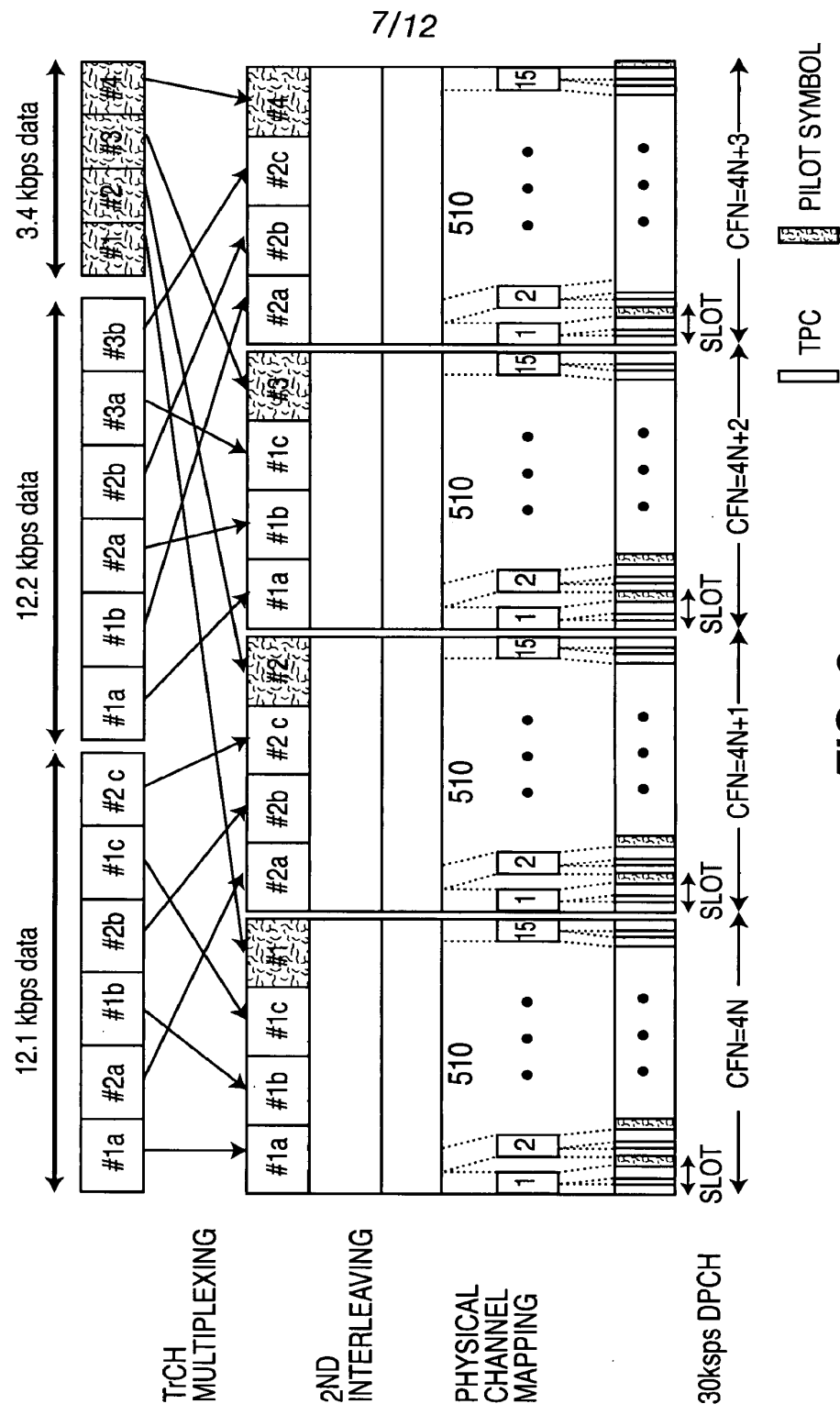


FIG. 6
PRIOR ART

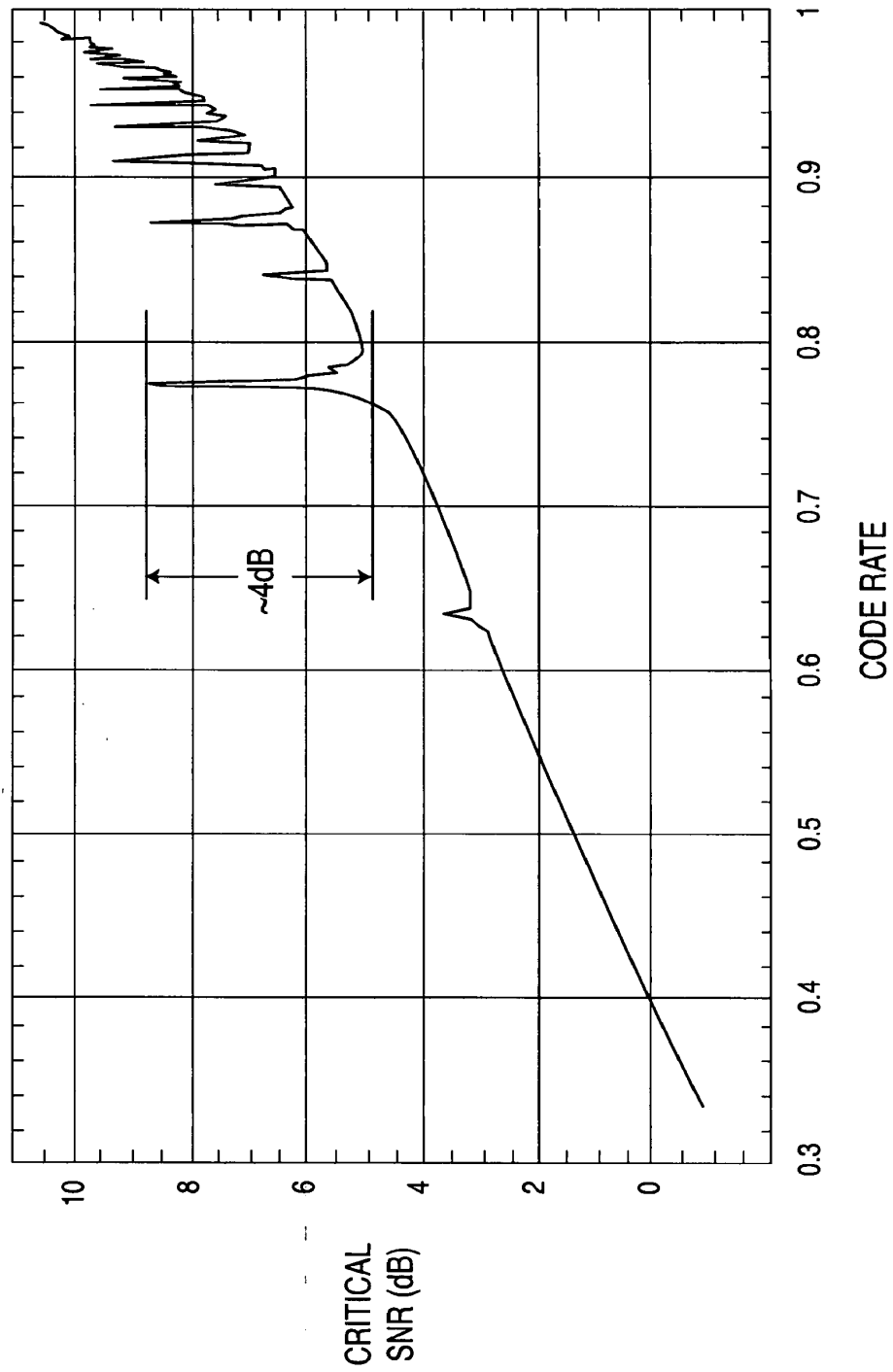


FIG. 7
PRIOR ART

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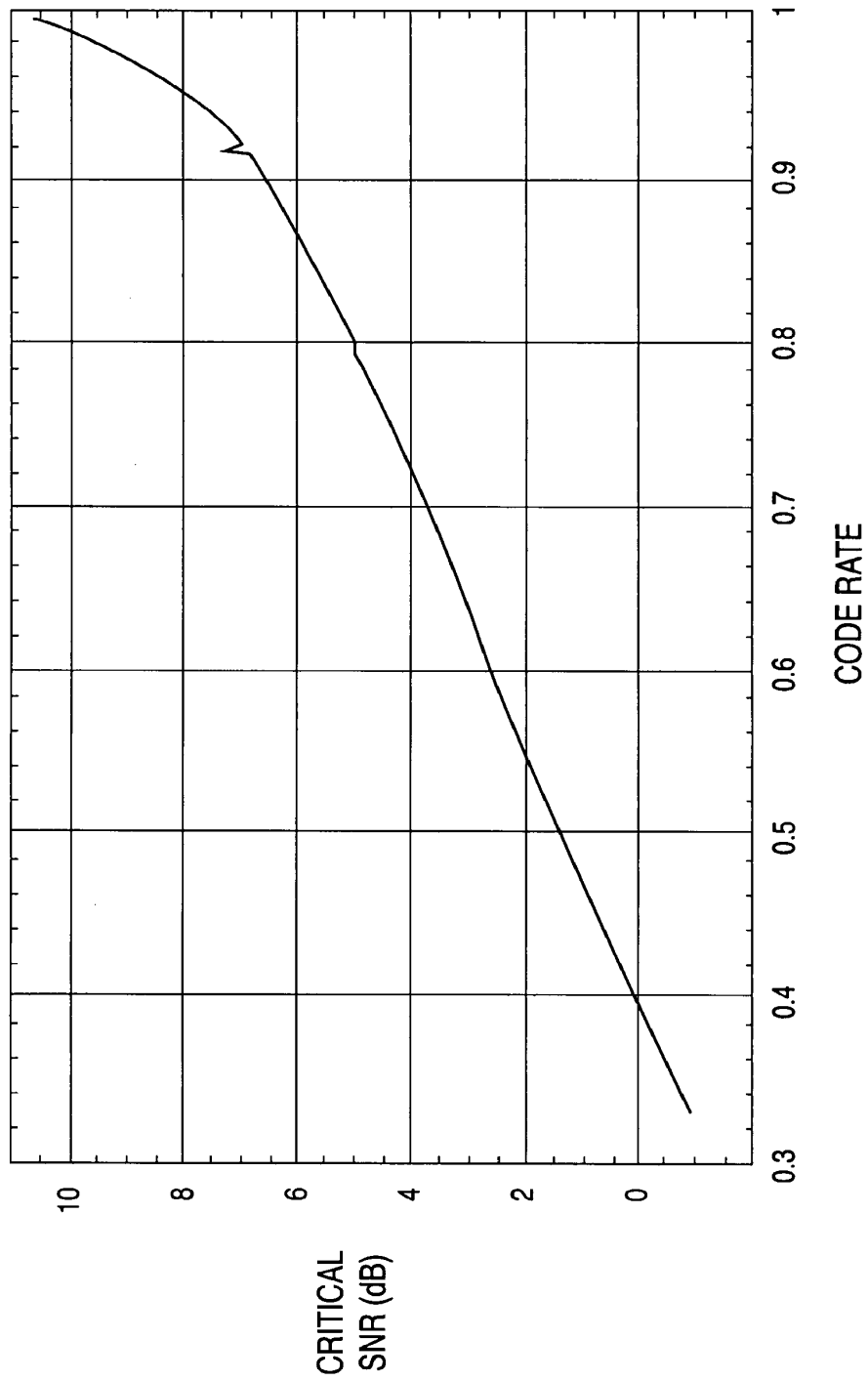


FIG. 8



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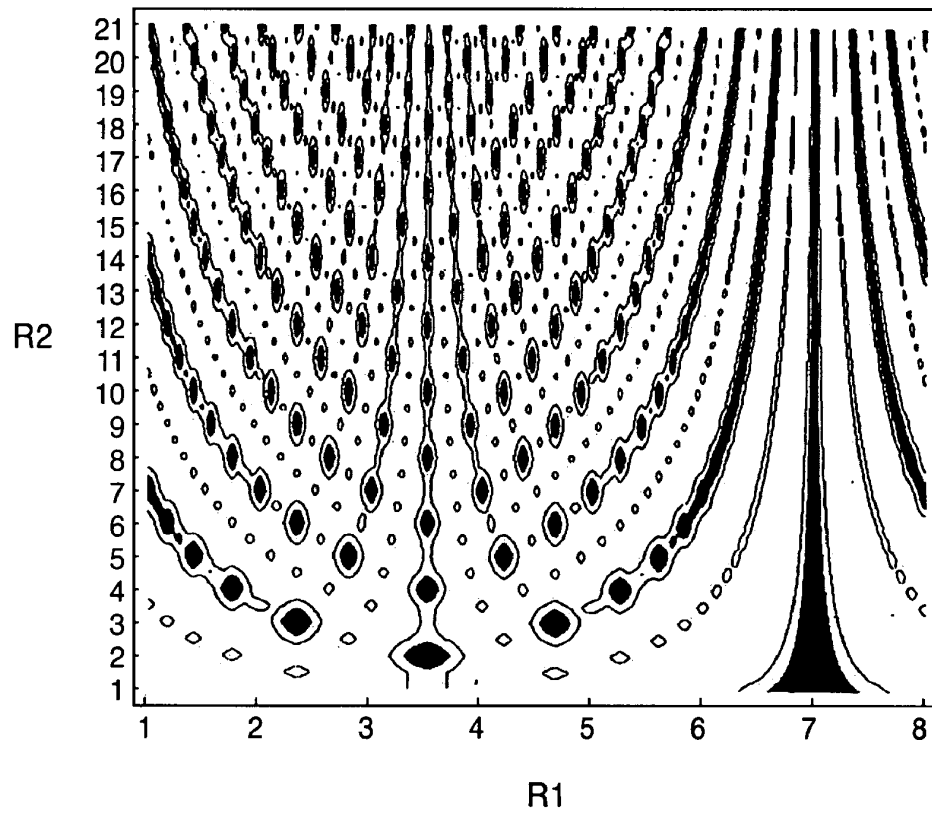
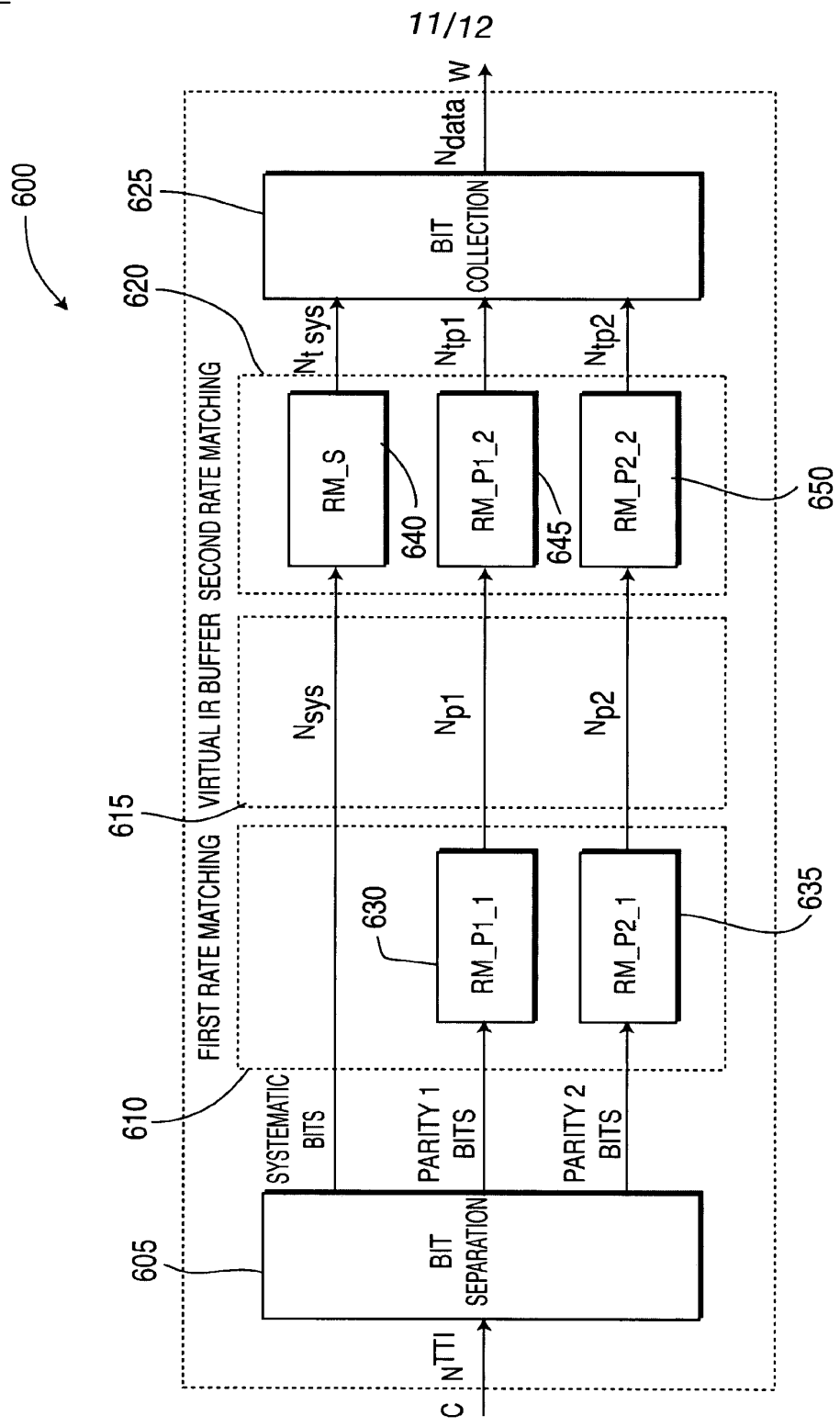


FIG. 9

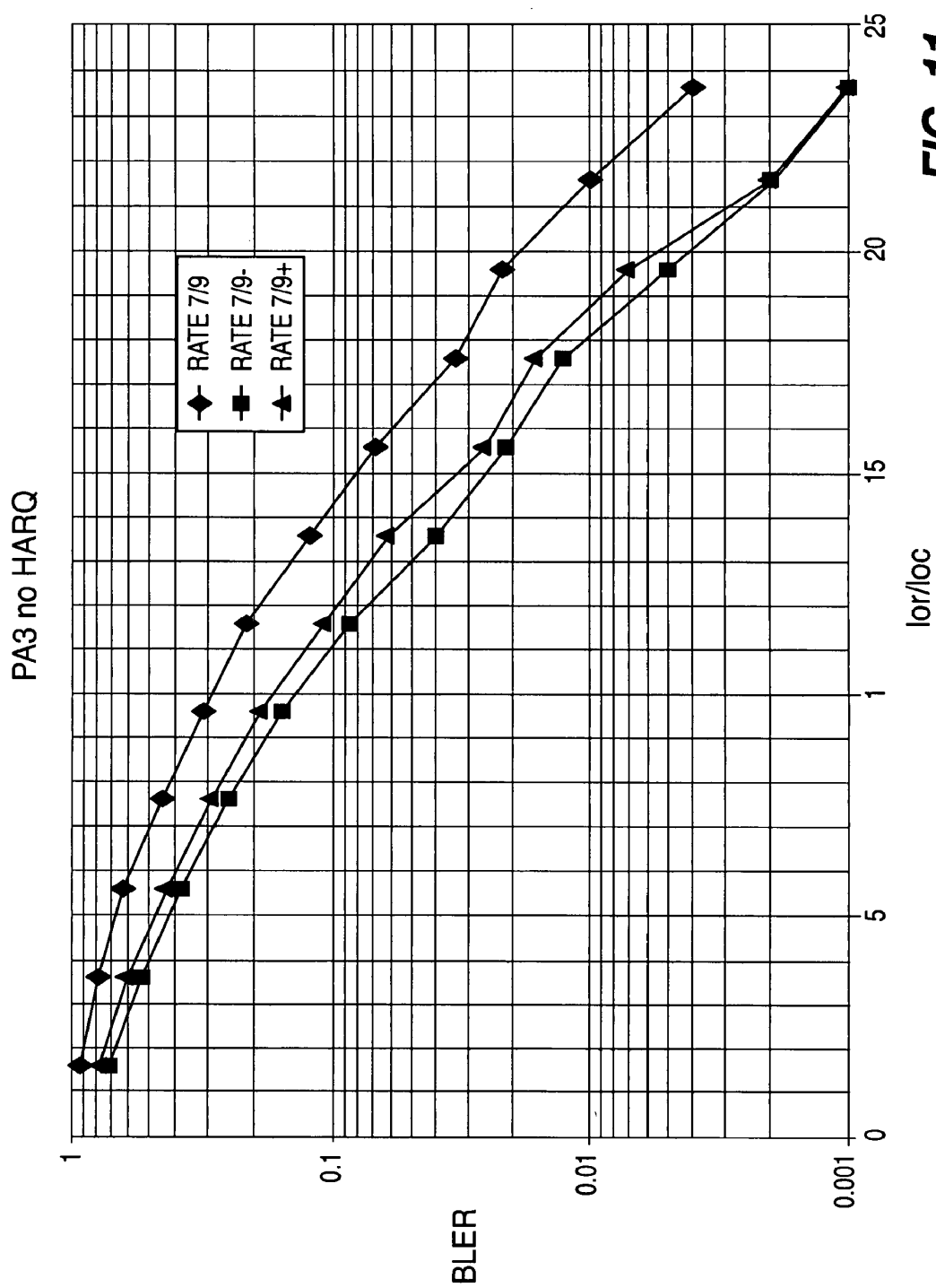




11/12

FIG. 10



**FIG. 11**

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	I-2-0526US06
		Application Number	
Title of Invention	DETECTION, AVOIDANCE AND/OR CORRECTION OF PROBLEMATIC PUNCTURING PATTERNS IN PARITY BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES		
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	
	Philip	J.	Pietraski		
Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service					
City	Jericho	State/Province	NY	Country of Residence i	US
Mailing Address of Inventor:					
Address 1	39 Marian Lane				
Address 2					
City	Jericho	State/Province	NY		
Postal Code	11753	Country i	US		
Inventor 2					Remove
Legal Name					
Prefix	Given Name	Middle Name	Family Name	Suffix	
	Gregory	S.	Sternberg		
Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service					
City	Mt. Laurel	State/Province	NJ	Country of Residence i	US
Mailing Address of Inventor:					
Address 1	7 Brookwood Road				
Address 2					
City	Mt. Laurel	State/Province	NJ		
Postal Code	08054	Country i	US		
All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the Add button.					Add

Correspondence Information:

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

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	I-2-0526US06
		Application Number	
Title of Invention	DETECTION, AVOIDANCE AND/OR CORRECTION OF PROBLEMATIC PUNCTURING PATTERNS IN PARITY BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES		

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

Customer Number	24374		
Email Address	eoffice@vklaw.com	Add Email	Remove Email

Application Information:

Title of the Invention	DETECTION, AVOIDANCE AND/OR CORRECTION OF PROBLEMATIC PUNCTURING PATTERNS IN PARITY BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES		
Attorney Docket Number	I-2-0526US06	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	12	Suggested Figure for Publication (if any)	10

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

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	24374		

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	I-2-0526US06
		Application Number	
Title of Invention	DETECTION, AVOIDANCE AND/OR CORRECTION OF PROBLEMATIC PUNCTURING PATTERNS IN PARITY BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this 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 blank.

Prior Application Status	Pending	Remove			
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)		
	Continuation of	13744984	2013-01-18		
Prior Application Status	Patented	Remove			
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13744984	Continuation of	13309962	2011-12-02	8359520	2013-01-22
Prior Application Status	Patented	Remove			
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13309962	Continuation of	11974381	2007-10-12	8074143	2011-12-06
Prior Application Status	Patented	Remove			
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
11974381	Continuation of	10725779	2003-12-02	7293217	2007-11-06
Prior Application Status	Expired	Remove			
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)		
10725779	Claims benefit of provisional	60470921	2003-05-15		
Prior Application Status	Expired	Remove			
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)		
60470921	Claims benefit of provisional	60444068	2003-01-30		
Prior Application Status	Expired	Remove			
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)		
60444068	Claims benefit of provisional	60434232	2002-12-16		
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button.					Add

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(d). When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(h)(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).

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	I-2-0526US06
		Application Number	
Title of Invention	DETECTION, AVOIDANCE AND/OR CORRECTION OF PROBLEMATIC PUNCTURING PATTERNS IN PARITY BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES		

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

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.

Authorization to Permit Access:

☒ Authorization to Permit Access to the Instant Application by the Participating Offices
If 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 World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application. In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application. In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date of filing this Authorization.

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.

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	I-2-0526US06
		Application Number	
Title of Invention	DETECTION, AVOIDANCE AND/OR CORRECTION OF PROBLEMATIC PUNCTURING PATTERNS IN PARITY BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES		

Applicant 1				Remove	
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		☐ Joint Inventor	
☐ 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		InterDigital Technology Corporation			
Mailing Address Information:					
Address 1		200 Bellevue Parkway			
Address 2		Suite 300			
City		Wilmington	State/Province		DE
Country	US	Postal Code		19809	
Phone Number		Fax Number			
Email Address					
Additional Applicant Data may be generated within this form by selecting the Add button. Add					

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.	
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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.	
Remove	
If the Assignee or Non-Applicant Assignee is an Organization check here. ☒	

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	I-2-0526US06
		Application Number	
Title of Invention	DETECTION, AVOIDANCE AND/OR CORRECTION OF PROBLEMATIC PUNCTURING PATTERNS IN PARITY BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES		

Organization Name	InterDigital Technology Corporation
-------------------	-------------------------------------

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1	200 Bellevue Parkway		
Address 2	Suite 300		
City	Wilmington	State/Province	DE
Country i	US	Postal Code	19809
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button.

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Signature:

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

Signature	/Wesley T. McMichael/		Date (YYYY-MM-DD)	2014-06-10
First Name	Wesley T.	Last Name	McMichael	Registration Number
			56982	

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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).
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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.
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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.



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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
14/300,734	06/10/2014	2112	1600	I-2-0526US06	6	3

CONFIRMATION NO. 1001

24374
VOLPE AND KOENIG, P.C.
DEPT. ICC
UNITED PLAZA
30 SOUTH 17TH STREET
PHILADELPHIA, PA 19103

FILING RECEIPT



Date Mailed: 06/20/2014

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)

Philip J. Pietraski, Jericho, NY;
Gregory S. Sternberg, Mt. Laurel, NJ;

Applicant(s)

InterDigital Technology Corporation, Wilmington, DE

Assignment For Published Patent Application

INTERDIGITAL TECHNOLOGY CORPORATION, Wilmington, DE

Power of Attorney: The patent practitioners associated with Customer Number 24374

Domestic Priority data as claimed by applicant

This application is a CON of 13/744,984 01/18/2013
which is a CON of 13/309,962 12/02/2011 PAT 8359520
which is a CON of 11/974,381 10/12/2007 PAT 8074143
which is a CON of 10/725,779 12/02/2003 PAT 7293217
which claims benefit of 60/470,921 05/15/2003

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.

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If Required, Foreign Filing License Granted: 06/19/2014

page 1 of 3

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 14/300,734**

Projected Publication Date: 09/25/2014

Non-Publication Request: No

Early Publication Request: No
Title

DETECTION, AVOIDANCE AND/OR CORRECTION OF PROBLEMATIC PUNCTURING
PATTERNS IN PARITY BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES

Preliminary Class

714

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

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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.

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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>.

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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875						Application or Docket Number 14/300,734	
APPLICATION AS FILED - PART I							
(Column 1)		(Column 2)		SMALL ENTITY		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(i))	6	minus 20 = *				x 80 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3	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	
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	
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY	
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.							



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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/300,734	06/10/2014	Philip J. Pietraski	I-2-0526US06

CONFIRMATION NO. 1001

IMPROPER CFR REQUEST



24374
VOLPE AND KOENIG, P.C.
DEPT. ICC
UNITED PLAZA
30 SOUTH 17TH STREET
PHILADELPHIA, PA 19103

Date Mailed: 06/20/2014

RESPONSE TO REQUEST FOR CORRECTED FILING RECEIPT

Continuity, Priority Claims, Petitions, and Non-Publication Requests

In response to your request for a corrected Filing Receipt, the Office is unable to comply with your request because:

- One or more of the benefit claims under 35 U.S.C. § 120 cannot be included on the Filing Receipt since applicant did not specify whether the application is a continuation, divisional or continuation-in-part of the prior application. Applicant must submit a new application data sheet (ADS) that sets forth the relationship, and the ADS must be accompanied by a petition under 37 CFR 1.78 if filed after the time period set forth in 37 CFR 1.78.

/bdemissie/

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

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	14/300,734
	Filing Date	2014-06-10
	First Named Inventor	Pietraski et al.
	Art Unit	2112
	Examiner Name	Fritz Alphonse
	Attorney Docket Number	I-2-0526US06

U.S. PATENT DOCUMENTS								
EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE	
		6,266,795	07/2001	Wei				
		6,370,669	04/2002	Eroz et al.				
		6,397,367	05/2002	Park et al. ⁵				
		6,476,734	11/2002	Jeong et al. ⁷				
		6,601,214	07/2003	Hammons, Jr.				
		6,622,281	09/2003	Yun et al. ⁶				
		6,631,491	10/2003	Shibutani et al.				
		6,665,813	12/2003	Forsman et al.				
		6,665,833	12/2003	Tong et al.				
		6,744,744	06/2004	Tong et al. ⁸				
		6,845,482	01/2005	Yao et al.				
		7,028,230	04/2006	Manninen et al.				
		7,076,726	07/2006	Yun et al.				
		7,089,450	08/2006	Anderson et al.				
		7,295,625	11/2007	Doetsch et al.				
		2002/0027956	03/2002	Lee et al.				
		2002/0141433	10/2002	Kwon et al.				
		2003/0007476	01/2003	Kim et al.				
FOREIGN PATENT DOCUMENTS								
EXAMINER INITIAL		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION	
							YES	NO
		00/011791	03/2000	WO ¹				
		00/041343	07/2000	WO ²				
		00/065446	06/2000	WO				
		00/48353	08/2000	WO				
EXAMINER				DATE CONSIDERED				

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

3155984-1

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	14/300,734
	Filing Date	2014-06-10
	First Named Inventor	Pietraski et al.
	Art Unit	2112
	Examiner Name	Fritz Alphonse
	Attorney Docket Number	I-2-0526US06

EXAMINER INITIAL		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION	
							YES	NO
		02/033910	04/2002	WO ³				
		03/069784	08/2003	WO ⁴				
		2002-0004478	01/2002	KR			X**	

OTHER DOCUMENTS

EXAMINER INITIAL		DESCRIPTION (Including Author, Title, Date, Pertinent Pages, Etc.)
		"Universal Mobile Telecommunications System (UMTS); Multiplexing and channel coding (FDD); (3GPP TS 25.212 version 5.1.0 Release 5)," ETSI TS 125 212 V5.1.0 (June 2002).
		INTERDIGITAL, "Turbo-Coding And Puncturing Interactions On HS-DSCH In R5 HSDPA", TSG-RAN Working Group 1 Meeting #32, R1-030444, (Paris, France 19-23 May 2003).
		Mo et al., "Analysis of Puncturing Pattern for High Rate Turbo Codes," IEEE International, 0-7803-5538-5/99, 1999, pgs. 547-550.
		NORTEL NETWORKS, "Proposal for Rate Matching for Turbo Codes," pp. 1-5 (May 12, 1999).
		SIEMENS ET AL., "HSDPA For The 1,28 Mcps TDD Option – A-VRC Test Methodology And Simulation Assumptions", TSG-RAN Working Group 4 (Radio) Meeting #26, R4-030223, (Madrid, Spain 17-21 February 2003).
		SIEMENS, "Turbo Coder Irregularities In HSDPA", 3GPP TSG-RAN Working Group 1 #32, Toc R1-030421, (Paris, France 19-23 May 2003).
		THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (FDD) (Release 6)", 3GPP TS 25.212 V6.1.0 (March 2004).
		THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (TDD) (Release 6)", 3GPP TS 25.222 V6.0.0 (December 2003).
		THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Channel Coding And Multiplexing Examples (Release 4)", 3GPP TS 25.944 V4.1.0 (June 2001).

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

3155984-1

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	14/300,734
	Filing Date	2014-06-10
	First Named Inventor	Pietraski et al.
	Art Unit	2112
	Examiner Name	Fritz Alphonse
	Attorney Docket Number	I-2-0526US06

EXAMINER INITIAL	DESCRIPTION (Including Author, Title, Date, Pertinent Pages, Etc.)
	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Medium Access Control (MAC) Protocol Specification (Release 5)", 3GPP TS 25.321 V5.6.0 (September 2003).
	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; MAC Protocol Specification (Release 5)", 3GPP TS 25.321 V5.2.0 (September 2002).
	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Medium Access Control (MAC) Protocol Specification (Release 4)", 3GPP TS 25.321 V4.9.0 (September 2003).
	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; MAC Protocol Specification (Release 4)", 3GPP TS 25.321 V4.6.0 (September 2002).
	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Medium Access Control (MAC) Protocol Specification (Release 1999)", 3GPP TS 25.321 V3.16.0 (September 2003).
	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; MAC Protocol Specification (Release 1999)", 3GPP TS 25.321 V3.13.0 (September 2002).
	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Channel Coding And Multiplexing Samples (Release 1999)", 3GPP TR 25.944 V3.5.0 (June 2001).
	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (FDD) (Release 5)", 3GPP TS 25.212 V5.2.0 (September 2002).
	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (FDD) (Release 5)", 3GPP TS 25.212 V5.4.0 (March 2003).
	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (FDD) (Release 5)", 3GPP TS 25.212 V5.6.0 (September 2003).
	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (TDD) (Release 5)", 3GPP TS 25.222 V5.7.0 (September 2004).
	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (TDD) (Release 1999)", 3GPP TS 25.222 V3.8.0 (March 2002).

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

3155984-1

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	14/300,734
	Filing Date	2014-06-10
	First Named Inventor	Pietraski et al.
	Art Unit	2112
	Examiner Name	Fritz Alphonse
	Attorney Docket Number	I-2-0526US06

EXAMINER INITIAL	DESCRIPTION (Including Author, Title, Date, Pertinent Pages, Etc.)
	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (TDD) (Release 1999)", 3GPP TS 25.222 V3.10.0 (September 2002).
	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (TDD) (Release 4)", 3GPP TS 25.222 V4.5.0 (September 2002).
	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (TDD) (Release 4)", 3GPP TS 25.222 V4.6.0 (December 2002).
	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (TDD) (Release 5)", 3GPP TS 25.222 V5.2.1 (October 2002).
	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (TDD) (Release 5)", 3GPP TS 25.222 V5.4.0 (March 2003).
	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (TDD) (Release 5)", 3GPP TS 25.222 V5.5.0 (June 2003).
	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; High Speed Downlink Packet Access: Physical Layer Aspects (Release 5)", 3GPP TR 25.858 V5.0.0 (March 2002).

¹ Equivalent to RU 2190296; ² Equivalent to RU 2185025; ³ Equivalent to RU 2239292; ⁴ Equivalent to RU 2004127246;

⁵ Equivalent to TW 478258 and TW 454391; ⁶ Equivalent to DE 1030407; ⁷ Equivalent to JP 2002-164948; ⁸ Equivalent to JP 2001-057521; ⁹ Corresponds to KR 2001-0052246.

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

3155984-1

Electronic Acknowledgement Receipt	
EFS ID:	19593298
Application Number:	14300734
International Application Number:	
Confirmation Number:	1001
Title of Invention:	DETECTION, AVOIDANCE AND/OR CORRECTION OF PROBLEMATIC PUNCTURING PATTERNS IN PARITY BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES
First Named Inventor/Applicant Name:	Philip J. Pietraski
Customer Number:	24374
Filer:	Wesley T. McMichael/Carey Kulp
Filer Authorized By:	Wesley T. McMichael
Attorney Docket Number:	I-2-0526US06
Receipt Date:	16-JUL-2014
Filing Date:	10-JUN-2014
Time Stamp:	13:40:36
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	IDS.pdf	58344 5d6dd3363ca143a8be26bc812db74da7208121d8	no	2

Warnings:

Information:

2	Information Disclosure Statement (IDS) Form (SB08)	MasterList.pdf	79261 97c46066c5d8f3b6542c79cd5834c517eec8e84d	no	4
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
Total Files Size (in bytes):			137605		
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.					

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the PATENT APPLICATION of:

Pietraski et al.

Application No.: 14/300,734

Confirmation No.: 1001

Filed: June 10, 2014

For: DETECTION, AVOIDANCE AND/OR
CORRECTION OF PROBLEMATIC
PUNCTURING PATTERNS IN PARITY BIT
STREAMS USED WHEN IMPLEMENTING
TURBO CODES

Group: 2112

Examiner: Fritz Alphonse

Our File: I-2-0526US06

Date: July 16, 2014

INFORMATION DISCLOSURE STATEMENT

Mail Stop Amendment (via EFS)
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Madam:

Further to Applicants' Duty of Disclosure pursuant to 37 C.F.R. §1.56,
Applicants wish to bring to the Examiner's attention the material cited on the enclosed
Information Disclosure Statement Form.

This Application is a continuation of U.S. Patent Application No. 13/744,984,
which was filed on January 18, 2013, which is a continuation of U.S. Patent
Application No. 13/309,962, filed on December 2, 2011, which issued on January 22,
2013 as U.S. Patent No. 8,359,520, which is a continuation of U.S. Patent Application

3156005-1

Applicant: Pietraski et al.
Application No.: 14/300,734

No. 11/974,381, filed on October 12, 2007, which issued on December 6, 2011 as U.S. Patent No., which is a continuation of U.S. Patent Application No. 10/725,779, filed on December 2, 2003, which issued on November 6, 2007 as U.S. Patent No. 7,293,217, which claims priority from Provisional Application No. 60/494,404, which was filed on August 11, 2003, Provisional Application No. 60/434,232, which was filed on December 16, 2002, Provisional Application No. 60/444,068, which was filed on January 30, 2003, and Provisional Application No. 60/470,921, which was filed on May 15, 2003.

Pursuant to 37 C.F.R. §1.98(d) copies of documents cited in the parent application are not enclosed, but copies will be provided upon request.

It is respectfully requested that the Examiner consider these documents and return an initialed copy of the Information Disclosure Statement Form indicating consideration of the cited materials.

Respectfully submitted,

Pietraski et al.

By /Wesley T. McMichael/_____
Wesley T. McMichael
Registration No. 56,982
(215) 568-6400

Volpe and Koenig, P.C.
United Plaza, Suite 1800
30 South 17th Street
Philadelphia, PA 19103

WTM/PCK
Enclosure

PLUS Search Results for S/N 14300734, Searched Wed Sep 24 14:04:24 EDT 2014
 The Patent Linguistics Utility System (PLUS) is a USPTO automated search system for U.S. Patents from 1971 to the present PLUS is a query-by-example search system which produces a list of patents that are most closely related linguistically to the application searched. This search was prepared by the staff of the Scientific and Technical Information Center, SIRA.

20020051501 88	7673213 81	20010010710 81
6088387 81	7676731 81	20010034209 81
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PLUS Search Results for S/N 14300734, Searched Wed Sep 24 14:04:24 EDT 2014
 The Patent Linguistics Utility System (PLUS) is a USPTO automated search system for U.S. Patents from 1971 to the present PLUS is a query-by-example search system which produces a list of patents that are most closely related linguistically to the application searched. This search was prepared by the staff of the Scientific and Technical Information Center, SIRA.

20020051501 88	7673213 81	20010010710 81
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7640486 81	20010009569 81	



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United States Patent and Trademark Office
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/300,734	06/10/2014	Philip J. Pietraski	I-2-0526US06

CONFIRMATION NO. 1001

PUBLICATION NOTICE



24374
VOLPE AND KOENIG, P.C.
DEPT. ICC
UNITED PLAZA
30 SOUTH 17TH STREET
PHILADELPHIA, PA 19103

Title:DETECTION, AVOIDANCE AND/OR CORRECTION OF PROBLEMATIC PUNCTURING PATTERNS IN PARITY BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES

Publication No.US-2014-0289592-A1

Publication Date:09/25/2014

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 Office of Public Records. The Office of Public Records can be reached by telephone at (703) 308-9726 or (800) 972-6382, by facsimile at (703) 305-8759, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, 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 <http://pair.uspto.gov/>. 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



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/300,734	06/10/2014	Philip J. Pietraski	I-2-0526US06	1001

24374 7590 10/03/2014
VOLPE AND KOENIG, P.C.
DEPT. ICC
UNITED PLAZA
30 SOUTH 17TH STREET
PHILADELPHIA, PA 19103

EXAMINER	
ALPHONSE, FRITZ	

ART UNIT	PAPER NUMBER
2112	

NOTIFICATION DATE	DELIVERY MODE
10/03/2014	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):

coffice@volpe-koenig.com

1. The present application is being examined under the pre-AIA first to invent provisions.
2. This Office Action is in regard to the application filed on 06/10/2014. Claims 1-6 are presented for examination.

Information Disclosure Statement

3. The Information Disclosure Statement (IDS) submitted is in compliance with the provisions of 37 CFR 1.97. Accordingly, the information disclosure statement has been considered by the examiner.

Oath/Declaration

4. The Oath/Declaration filed on 06/10/2014 is accepted.

Double Patenting

5. 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 double patenting rejection is appropriate where the claims at issue 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 reference application or patent either is shown to 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. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO internet Web site contains terminal disclaimer forms which may be used. Please visit <http://www.uspto.gov/forms/>. The filing date of the application will determine what form should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to <http://www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp>.

6. Claims 1-6 are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-8 of U.S. Patent No. 8,074,143. Although the claims at issue are not identical, they are not patentably distinct from each other because claim 1-6 of the present application are substantially equivalent to claims 1-8 of U.S. Patent No. 8,074,143.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. See PTO-892.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Fritz Alphonse, whose telephone number is (571) 272-3813. The examiner can normally be reached on M-F, 8:30-6:00, Alt. Mondays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Albert Decady, can be reached at (571) 272-3819.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (571) 272-3824

Information regarding the status of an application may also 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).

/Fritz Alphonse/

Primary Examiner, Art Unit 2112

Notice of References Cited	Application/Control No. 14/300,734	Applicant(s)/Patent Under Reexamination PIETRASKI ET AL.	
	Examiner FRITZ ALPHONSE	Art Unit 2112	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-2009/0041110	02-2009	Malladi, Durga Prasad	375/240
*	B	US-8,726,121	05-2014	Malladi et al.	714/755
	C	US-			
	D	US-			
	E	US-			
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L7	828955	wireless near4 communication	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/30 09:45
L8	593	(first and second and third) near4 interleaver	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/30 09:45
L9	139	L7 and L8	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/30 09:45
L10	18	L9 and buffer interleav\$5 bit	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/30 09:45
L11	10	L10 and parity near4 bit	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/30 09:45
L12	7	L11 and rate near4 matching	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/30 09:45
L13	7	12 AND ((H03M13/2771 OR H03M13/2957 OR H03M13/6362 OR H03M13/6381 OR H03M13/005 OR H03M13/2792 OR H03M13/635 OR H04L1/0066 OR H04L1/0067 OR H04L1/0071 OR H04L1/0013 OR H04L1/1812 OR H04L1/0041 OR H04L1/005).CPC. AND (714/786 OR 714/790 OR 714/755 OR 714/E11.032	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/30 09:58

		OR 714/752 OR 714/774 OR 714/776 OR 375/240).CCLS. AND (H03M13/00 OR H03M13/27 OR H03M13/03 OR H03M13/05 OR G06F11/00 OR G06F11/10 OR H04B1/66).IPCR.)				
S1	70	(pietraski near4 philip)	USPAT	OR	OFF	2014/09/27 16:03
S2	704	(pietraski near4 philip)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2014/09/27 16:15
S3	265	(Sternberg near4 gregory)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2014/09/27 16:16
S4	825	S2 S3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2014/09/27 16:16
S5	10	S4 and (wireless communication interleaver bit parity buffer rate matching)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	AND	OFF	2014/09/27 16:18
S6	0	S4 and (wireless communication interleaver bit parity buffer rate matching).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	AND	OFF	2014/09/27 16:18
S7	704	(pietraski near4 philip)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2014/09/27 20:42
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S9	825	S7 S8	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	OFF	2014/09/27 20:42

			DERWENT; IBM_TDB			
S10	10	S9 and (wireless communication interleaver bit parity buffer rate matching)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	AND	OFF	2014/09/27 20:42
S11	0	(detect\$4 and correct\$\$) parity bit turbo codecode rate	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/27 20:43
S12	0	(detect\$4 and correct\$\$) parity bit turbo codecode rate	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/27 20:43
S13	77	(detect\$4 and correct\$\$) parity bit turbo code rate	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/27 20:44
S14	828185	wireless near4 communication	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/27 20:44
S15	0	(first and second and third) near4 interleacer	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/27 20:46
S16	591	(first and second and third) near4 interleaver	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/27 20:46
S17	137	S14 and S16	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/27 20:46
S18	17	S17 and buffer interleav\$5 bit	US-PGPUB; USPAT; USOCR;	SAME	OFF	2014/09/27 20:47

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S22	272	("20020051501" "6088387" "6028897" "6014411" "6044116" "6370669" "6397367" "6480503" "6553539" "6601214" "6621873" "6622281" "6665833" "6675348" "6697986" "6744744" "6807238" "6816556" "6829305" "6892342" "6903665" "7000173" "7000174" "7016427" "7016658" "7027782" "7072307" "7089480" "7114121" "7146552" "7165209" "7200792" "7210089"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2014/09/27 20:51

EAST Search History

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9/ 30/ 2014 10:03:53 AM

C:\Users\falphonse\Documents\EAST\Workspaces\14300734.wsp

<i>Index of Claims</i> 	Application/Control No. 14300734	Applicant(s)/Patent Under Reexamination PIETRASKI ET AL.
	Examiner FRITZ ALPHONSE	Art Unit 2112

✓	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	09/30/2014									
	1	✓									
	2	✓									
	3	✓									
	4	✓									
	5	✓									
	6	✓									

Search Notes 	Application/Control No. 14300734	Applicant(s)/Patent Under Reexamination PIETRASKI ET AL.
	Examiner FRITZ ALPHONSE	Art Unit 2112

CPC- SEARCHED		
Symbol	Date	Examiner
H03M 13/091	9/30/2014	FA

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner
H03M 13/2771	9/30/2014	FA

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
714	755,786,490,752,701,800	9/30/2014	FA

SEARCH NOTES		
Search Notes	Date	Examiner
East Search	9/30/2014	FA
Plus Search (See East Search)	9/30/2014	FA

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

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09/30/2014

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	14/300,734
	Filing Date	2014-06-10
	First Named Inventor	Pietraski et al.
	Art Unit	2112
	Examiner Name	Fritz Alphonse
	Attorney Docket Number	I-2-0526US06

U.S. PATENT DOCUMENTS								
EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE	
/F.A./		6,266,795	07/2001	Wei				
		6,370,669	04/2002	Eroz et al.				
		6,397,367	05/2002	Park et al. ⁵				
		6,476,734	11/2002	Jeong et al. ⁷				
		6,601,214	07/2003	Hammons, Jr.				
		6,622,281	09/2003	Yun et al. ⁶				
		6,631,491	10/2003	Shibutani et al.				
		6,665,813	12/2003	Forsman et al.				
		6,665,833	12/2003	Tong et al.				
		6,744,744	06/2004	Tong et al. ⁸				
		6,845,482	01/2005	Yao et al.				
		7,028,230	04/2006	Manninen et al.				
		7,076,726	07/2006	Yun et al.				
		7,089,450	08/2006	Anderson et al.				
		7,295,625	11/2007	Doetsch et al.				
		2002/0027956	03/2002	Lee et al.				
		2002/0141433	10/2002	Kwon et al.				
		2003/0007476	01/2003	Kim et al.				
FOREIGN PATENT DOCUMENTS								
EXAMINER INITIAL		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION	
							YES	NO
/F.A./		00/011791	03/2000	WO ¹				
/F.A./		00/041343	07/2000	WO ²				
/F.A./		00/065446	06/2000	WO				
/F.A./		00/48353	08/2000	WO				
EXAMINER				DATE CONSIDERED				
/Fritz Alphonse/				09/30/2014				

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3155984-1

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EXAMINER INITIAL		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION	
							YES	NO
/F.A./		02/033910	04/2002	WO ³				
/F.A./		03/069784	08/2003	WO ⁴				
/F.A./		2002-0004478	01/2002	KR			X**	

OTHER DOCUMENTS

EXAMINER INITIAL		DESCRIPTION (Including Author, Title, Date, Pertinent Pages, Etc.)
/F.A./		"Universal Mobile Telecommunications System (UMTS); Multiplexing and channel coding (FDD); (3GPP TS 25.212 version 5.1.0 Release 5)," ETSI TS 125 212 V5.1.0 (June 2002).
/F.A./		INTERDIGITAL, "Turbo-Coding And Puncturing Interactions On HS-DSCH In R5 HSDPA", TSG-RAN Working Group 1 Meeting #32, R1-030444, (Paris, France 19-23 May 2003).
/F.A./		Mo et al., "Analysis of Puncturing Pattern for High Rate Turbo Codes," IEEE International, 0-7803-5538-5/99, 1999, pgs. 547-550.
/F.A./		NORTEL NETWORKS, "Proposal for Rate Matching for Turbo Codes," pp. 1-5 (May 12, 1999).
/F.A./		SIEMENS ET AL., "HSDPA For The 1,28 Mcps TDD Option – A-VRC Test Methodology And Simulation Assumptions", TSG-RAN Working Group 4 (Radio) Meeting #26, R4-030223, (Madrid, Spain 17-21 February 2003).
/F.A./		SIEMENS, "Turbo Coder Irregularities In HSDPA", 3GPP TSG-RAN Working Group 1 #32, Toc R1-030421, (Paris, France 19-23 May 2003).
/F.A./		THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (FDD) (Release 6)", 3GPP TS 25.212 V6.1.0 (March 2004).
/F.A./		THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (TDD) (Release 6)", 3GPP TS 25.222 V6.0.0 (December 2003).
/F.A./		THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Channel Coding And Multiplexing Examples (Release 4)", 3GPP TS 25.944 V4.1.0 (June 2001).

EXAMINER /Fritz Alphonse/	DATE CONSIDERED 09/30/2014
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	Examiner Name	Fritz Alphonse
	Attorney Docket Number	I-2-0526US06

EXAMINER INITIAL	DESCRIPTION (Including Author, Title, Date, Pertinent Pages, Etc.)
/F.A./	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Medium Access Control (MAC) Protocol Specification (Release 5)", 3GPP TS 25.321 V5.6.0 (September 2003).
/F.A./	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; MAC Protocol Specification (Release 5)", 3GPP TS 25.321 V5.2.0 (September 2002).
/F.A./	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Medium Access Control (MAC) Protocol Specification (Release 4)", 3GPP TS 25.321 V4.9.0 (September 2003).
/F.A./	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; MAC Protocol Specification (Release 4)", 3GPP TS 25.321 V4.6.0 (September 2002).
/F.A./	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Medium Access Control (MAC) Protocol Specification (Release 1999)", 3GPP TS 25.321 V3.16.0 (September 2003).
/F.A./	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; MAC Protocol Specification (Release 1999)", 3GPP TS 25.321 V3.13.0 (September 2002).
/F.A./	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Channel Coding And Multiplexing Samples (Release 1999)", 3GPP TR 25.944 V3.5.0 (June 2001).
/F.A./	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (FDD) (Release 5)", 3GPP TS 25.212 V5.2.0 (September 2002).
/F.A./	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (FDD) (Release 5)", 3GPP TS 25.212 V5.4.0 (March 2003).
/F.A./	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (FDD) (Release 5)", 3GPP TS 25.212 V5.6.0 (September 2003).
/F.A./	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (TDD) (Release 5)", 3GPP TS 25.222 V5.7.0 (September 2004).
/F.A./	THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (TDD) (Release 1999)", 3GPP TS 25.222 V3.8.0 (March 2002).

EXAMINER /Fritz Alphonse/	DATE CONSIDERED 09/30/2014
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EXAMINER INITIAL		DESCRIPTION (Including Author, Title, Date, Pertinent Pages, Etc.)
/F.A./		THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (TDD) (Release 1999)", 3GPP TS 25.222 V3.10.0 (September 2002).
/F.A./		THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (TDD) (Release 4)", 3GPP TS 25.222 V4.5.0 (September 2002).
/F.A./		THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (TDD) (Release 4)", 3GPP TS 25.222 V4.6.0 (December 2002).
/F.A./		THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (TDD) (Release 5)", 3GPP TS 25.222 V5.2.1 (October 2002).
/F.A./		THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (TDD) (Release 5)", 3GPP TS 25.222 V5.4.0 (March 2003).
/F.A./		THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; Multiplexing And Channel Coding (TDD) (Release 5)", 3GPP TS 25.222 V5.5.0 (June 2003).
/F.A./		THIRD GENERATION PARTNERSHIP PROJECT, "Technical Specification Group Radio Access Network; High Speed Downlink Packet Access: Physical Layer Aspects (Release 5)", 3GPP TR 25.858 V5.0.0 (March 2002).

¹ Equivalent to RU 2190296; ² Equivalent to RU 2185025; ³ Equivalent to RU 2239292; ⁴ Equivalent to RU 2004127246;

⁵ Equivalent to TW 478258 and TW 454391; ⁶ Equivalent to DE 1030407; ⁷ Equivalent to JP 2002-164948; ⁸ Equivalent to JP 2001-057521; ⁹ Corresponds to KR 2001-0052246.

EXAMINER /Fritz Alphonse/	DATE CONSIDERED 09/30/2014
------------------------------	-------------------------------

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

3155984-1

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the **PATENT APPLICATION** of:

InterDigital Technology Corporation

Application No.: 14/300,734

Confirmation No.: 1001

Filed: June 10, 2014

For: DETECTION, AVOIDANCE AND/OR
CORRECTION OF PROBLEMATIC
PUNCTURING PATTERNS IN PARITY BIT
STREAMS USED WHEN IMPLEMENTING
TURBO CODES

Group: 2112

Examiner: Fritz Alphonse

Our File: I-2-0526US06

Date: December 30, 2014

RESPONSE PURSUANT TO 37 C.F.R. §1.111

Mail Stop Amendment (via EFS)
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Madam:

This Response and Terminal Disclaimer are being timely filed in response to
the Non-Final Office Action dated October 3, 2014.

Amendments to the Claims:

This listing of the claims will replace all prior versions of the claims in the application:

What is claimed is:

1. (Original) An apparatus for use in wireless communications comprising:

a first interleaver configured to interleave systematic bits;

a second interleaver configured to interleave a first parity bit stream;

a third interleaver configured to interleave a second parity bit stream;

a buffer configured to buffer the interleaved systematic bits, the interleaved first parity bit stream and the interleaved second parity bit stream; and

a rate matching unit configured to select bits for transmission based on a plurality of redundancy versions; wherein at least one redundancy version of the set selects systematic bits over first and second parity bits and at least one redundancy version of the set selects first and second parity bits over systematic bits.

2. (Original) The apparatus of claim 1 wherein selecting of bits by the rate matching unit in response to a selected redundancy version changes in response to a location of the bits in the buffer.

3. (Original) A method for use in an apparatus of a wireless communications comprising:

interleaving, by the apparatus, systematic bits;

interleaving, by the apparatus, a first parity bit stream;

interleaving, by the apparatus, a second parity bit stream;

buffering, by the apparatus, the interleaved systematic bits, the interleaved first parity bit stream and the interleaved second parity bit stream; and

selecting, by the apparatus, bits for transmission based on a plurality of redundancy versions; wherein at least one redundancy version of the set selects systematic bits over first and second parity bits and at least one redundancy version of the set selects first and second parity bits over systematic bits.

4. (Original) The method of claim 3 wherein the selecting of bits for transmission in response to a selected redundancy version changes in response to a location of the bits in the buffer.

5. (Original) A wireless transmit/receive unit comprising:

circuitry configured to interleave systematic bits;

circuitry is further configured to interleave a first parity bit stream;

circuitry is further configured to interleave a second parity bit stream;

circuitry is further configured to buffer the interleaved systematic bits, the interleaved first parity bit stream and the interleaved second parity bit stream; and

circuitry is further configured to select bits for transmission based on a plurality of redundancy versions; wherein at least one redundancy version of the set selects systematic bits over first and second parity bits and at least one redundancy version of the set selects first and second parity bits over systematic bits.

6. (Original) The wireless transmit/receive unit of claim 5 wherein selecting of bits based on a selected redundancy version changes in response to a location of the bits in the buffer.

Applicant: InterDigital Technology Corporation
Application No.: 14/300,734

REMARKS/ARGUMENTS

Claims 1-6 are currently pending in this application.

Double Patenting Rejection

Claims 1-6 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-8 of U.S. Patent No. 8,074,143. A Terminal Disclaimer is submitted herewith to overcome the obviousness-type double patenting rejection. Accordingly, withdrawal of the obviousness-type double patenting rejection is respectfully requested.

Applicant: InterDigital Technology Corporation
Application No.: 14/300,734

Conclusion

If the Examiner believes that any additional minor formal matters need to be addressed in order to place this application in condition for allowance, or that a telephonic interview will help to materially advance the prosecution of this application, the Examiner is invited to contact the undersigned by telephone at the Examiner's convenience.

In view of the foregoing, Applicants respectfully submit that the present application, including claims 1-6, is in condition for allowance and a notice to that effect is respectfully requested.

Respectfully submitted,

InterDigital Technology Corporation

By /Jeffrey M. Glabicki/
Jeffrey M. Glabicki
Registration No. 42,584

Volpe and Koenig, P.C.
United Plaza
30 South 17th Street
Philadelphia, PA 19103-4009
Telephone: (215) 568-6400
Facsimile: (215) 568-6499

JMG/JDW/bbf
Enclosure

TERMINAL DISCLAIMER TO OBIVATE A DOUBLE PATENTING REJECTION OVER A "PRIOR" PATENT	Docket Number (Optional) I-2-0526US06
In re Application of: InterDigital Technology Corporation Application No.: 14/300,734 Filed: June 10, 2014 For: DETECTION, AVOIDANCE AND/OR CORRECTION OF PROBLEMATIC PUNCTURING PATTERNS IN PARITY BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES The applicant, <u>InterDigital Technology Corporation</u>, owner of <u>100</u> 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. <u>8,074,143</u> 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. <u>42,584</u> <u>/Jeffrey M. Glabicki/</u> Signature <u>December 30, 2014</u> Date <u>Jeffrey M. Glabicki</u> Typed or printed name <u>Attorney</u> Title <u>215-568-6400</u> 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.

Electronic Patent Application Fee Transmittal				
Application Number:		14300734		
Filing Date:		10-Jun-2014		
Title of Invention:		DETECTION, AVOIDANCE AND/OR CORRECTION OF PROBLEMATIC PUNCTURING PATTERNS IN PARITY BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES		
First Named Inventor/Applicant Name:		Philip J. Pietraski		
Filer:		Jeffrey M. Glabicki/Belinda Fields		
Attorney Docket Number:		I-2-0526US06		
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description		Fee Code	Quantity	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:	21085948
Application Number:	14300734
International Application Number:	
Confirmation Number:	1001
Title of Invention:	DETECTION, AVOIDANCE AND/OR CORRECTION OF PROBLEMATIC PUNCTURING PATTERNS IN PARITY BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES
First Named Inventor/Applicant Name:	Philip J. Pietraski
Customer Number:	24374
Filer:	Jeffrey M. Glabicki/Belinda Fields
Filer Authorized By:	Jeffrey M. Glabicki
Attorney Docket Number:	I-2-0526US06
Receipt Date:	30-DEC-2014
Filing Date:	10-JUN-2014
Time Stamp:	12:38:45
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$ 160
RAM confirmation Number	13216
Deposit Account	090435
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees) Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)	

Charge any Additional Fees required under 37 C.F.R. Section 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		I_2_0526US06_Reply_20141230.PDF	75478 7f5f029163d4fe57dacaf1fc1e4acc40eda65371	yes	6
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Amendment/Req. Reconsideration-After Non-Final Reject		1	1	
	Claims		2	4	
	Applicant Arguments/Remarks Made in an Amendment		5	6	
Warnings:					
Information:					
2	Terminal Disclaimer Filed	I_2_0526US06_Terminal_Disclaimer_20141230.PDF	160773 ff3be10c45e4c93d963684b00c5ea85f97f61041	no	2
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	31031 2cf214f34b9dbb94d67dde3cacf59b26b209a496	no	2
Warnings:					
Information:					
Total Files Size (in bytes):			267282		

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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.

Application Number 	Application/Control No.	Applicant(s)/Patent under Reexamination	
	14/300,734	PIETRASKI ET AL.	
Document Code - DISQ		Internal Document – DO NOT MAIL	

TERMINAL DISCLAIMER	☒ APPROVED	☐ DISAPPROVED
Date Filed : 12/30/2014	This patent is subject to a Terminal Disclaimer	

Approved/Disapproved by:
Dorethea Lawrence

U.S. Patent and Trademark Office

PLUS Search Results for S/N 14300734, Searched Fri Jan 30 14:25:48 EST 2015
 The Patent Linguistics Utility System (PLUS) is a USPTO automated search system for U.S. Patents from 1971 to the present PLUS is a query-by-example search system which produces a list of patents that are most closely related linguistically to the application searched. This search was prepared by the staff of the Scientific and Technical Information Center, SIRA.

20020051501 87	7437655 81	8923413 81
20080137652 87	7458011 81	8943383 81
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7421033 81	8868988 81	



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NOTICE OF ALLOWANCE AND FEE(S) DUE

24374 7590 02/17/2015
VOLPE AND KOENIG, P.C.
DEPT. ICC
UNITED PLAZA
30 SOUTH 17TH STREET
PHILADELPHIA, PA 19103

EXAMINER

ALPHONSE, FRITZ

ART UNIT

PAPER NUMBER

2112

DATE MAILED: 02/17/2015

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/300,734	06/10/2014	Philip J. Pietraski	I-2-0526US06	1001

TITLE OF INVENTION: DETECTION, AVOIDANCE AND/OR CORRECTION OF PROBLEMATIC PUNCTURING PATTERNS IN PARITY BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$960	\$0	\$0	\$960	05/18/2015

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
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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.

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24374 7590 02/17/2015
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DEPT. ICC
UNITED PLAZA
30 SOUTH 17TH STREET
PHILADELPHIA, PA 19103

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.
14/300,734	06/10/2014	Philip J. Pietraski	I-2-0526US06	1001

TITLE OF INVENTION: DETECTION, AVOIDANCE AND/OR CORRECTION OF PROBLEMATIC PUNCTURING PATTERNS IN PARITY BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$960	\$0	\$0	\$960	05/18/2015

EXAMINER	ART UNIT	CLASS-SUBCLASS
ALPHONSE, FRITZ	2112	714-755000

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, 1 _____
- (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. 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. _____



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/300,734	06/10/2014	Philip J. Pietraski	I-2-0526US06	1001
24374 7590 02/17/2015 VOLPE AND KOENIG, P.C. DEPT. ICC UNITED PLAZA 30 SOUTH 17TH STREET PHILADELPHIA, PA 19103			EXAMINER ALPHONSE, FRITZ	
			ART UNIT	PAPER NUMBER
			2112	

DATE MAILED: 02/17/2015

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. 14/300,734	Applicant(s) PIETRASKI ET AL.	
	Examiner FRITZ ALPHONSE	Art Unit 2112	AIA (First Inventor to File) 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 on 12/30/2014.
☐ 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 1-6. 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)	5. ☐ Examiner's Amendment/Comment
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____	6. ☐ Examiner's Statement of Reasons for Allowance
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material	7. ☐ Other _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____.	

/FRITZ ALPHONSE/ Primary Examiner, Art Unit 2112	
---	--

Issue Classification 	Application/Control No. 14300734	Applicant(s)/Patent Under Reexamination PIETRASKI ET AL.	
	Examiner FRITZ ALPHONSE	Art Unit 2112	

CPC						
Symbol					Type	Version
H03M		13		2771	F	2013-01-01
H03M		13		2957	I	2013-01-01
H03M		13		6362	I	2013-01-01
H03M		13		6381	I	2013-01-01
H03M		13		005	I	2013-01-01
H03M		13		2792	I	2013-01-01

CPC Combination Sets				
Symbol	Type	Set	Ranking	Version

NONE		Total Claims Allowed:	
(Assistant Examiner)		6	
/FRITZ ALPHONSE/		(Date)	
Primary Examiner.Art Unit 2112		2/5/2015	
(Primary Examiner)		(Date)	
		O.G. Print Claim(s)	O.G. Print Figure
		1	10



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BIB DATA SHEET

CONFIRMATION NO. 1001

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.		
14/300,734	06/10/2014	714	2112	I-2-0526US06		
RULE						
APPLICANTS InterDigital Technology Corporation, Wilmington, DE, Assignee (with 37 CFR 1.172 Interest); INVENTORS Philip J. Pietraski, Jericho, NY; Gregory S. Sternberg, Mt. Laurel, NJ;						
** CONTINUING DATA ***** This application is a CON of 13/744,984 01/18/2013 PAT 8788920 which is a CON of 13/309,962 12/02/2011 PAT 8359520 which is a CON of 11/974,381 10/12/2007 PAT 8074143 which is a CON of 10/725,779 12/02/2003 PAT 7293217 which claims benefit of 60/470,921 05/15/2003						
** FOREIGN APPLICATIONS *****						
** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** 06/19/2014						
Foreign Priority claimed ☐ Yes ☒ No 35 USC 119(a-d) conditions met ☐ Yes ☒ No Verified and /FRITZ ALPHONSE/ Acknowledged Examiner's Signature		☐ Met after Allowance FA Initials	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
			NY	12	6	3
ADDRESS VOLPE AND KOENIG, P.C. DEPT. ICC UNITED PLAZA 30 SOUTH 17TH STREET PHILADELPHIA, PA 19103 UNITED STATES						
TITLE DETECTION, AVOIDANCE AND/OR CORRECTION OF PROBLEMATIC PUNCTURING PATTERNS IN PARITY BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES						
FILING FEE RECEIVED 1600	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:			☐ All Fees		
				☐ 1.16 Fees (Filing)		
				☐ 1.17 Fees (Processing Ext. of time)		
				☐ 1.18 Fees (Issue)		
				☐ Other _____		
				☐ Credit		

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L7	828955	wireless near4 communication	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/30 09:45
L8	593	(first and second and third) near4 interleaver	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/30 09:45
L9	139	L7 and L8	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/30 09:45
L10	18	L9 and buffer interleav\$5 bit	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/30 09:45
L11	10	L10 and parity near4 bit	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/30 09:45
L12	7	L11 and rate near4 matching	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/30 09:45
L13	7	12 AND ((H03M13/2771 OR H03M13/2957 OR H03M13/6362 OR H03M13/6381 OR H03M13/005 OR H03M13/2792 OR H03M13/635 OR H04L1/0066 OR H04L1/0067 OR H04L1/0071 OR H04L1/0013 OR H04L1/1812 OR H04L1/0041 OR H04L1/005).CPC. AND (714/786 OR 714/790 OR 714/755 OR 714/E11.032	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/30 09:58

		OR 714/752 OR 714/774 OR 714/776 OR 375/240).CCLS. AND (H03M13/00 OR H03M13/27 OR H03M13/03 OR H03M13/05 OR G06F11/00 OR G06F11/10 OR H04B1/66).IPCR.)				
S1	70	(pietraski near4 philip)	USPAT	OR	OFF	2014/09/27 16:03
S2	704	(pietraski near4 philip)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2014/09/27 16:15
S3	265	(Sternberg near4 gregory)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2014/09/27 16:16
S4	825	S2 S3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2014/09/27 16:16
S5	10	S4 and (wireless communication interleaver bit parity buffer rate matching)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	AND	OFF	2014/09/27 16:18
S6	0	S4 and (wireless communication interleaver bit parity buffer rate matching).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	AND	OFF	2014/09/27 16:18
S7	704	(pietraski near4 philip)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2014/09/27 20:42
S8	265	(Sternberg near4 gregory)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2014/09/27 20:42
S9	825	S7 S8	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	OFF	2014/09/27 20:42

			DERWENT; IBM_TDB			
S10	10	S9 and (wireless communication interleaver bit parity buffer rate matching)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	AND	OFF	2014/09/27 20:42
S11	0	(detect\$4 and correct\$\$) parity bit turbo codecode rate	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/27 20:43
S12	0	(detect\$4 and correct\$\$) parity bit turbo codecode rate	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/27 20:43
S13	77	(detect\$4 and correct\$\$) parity bit turbo code rate	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/27 20:44
S14	828185	wireless near4 communication	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/27 20:44
S15	0	(first and second and third) near4 interleacer	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/27 20:46
S16	591	(first and second and third) near4 interleaver	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/27 20:46
S17	137	S14 and S16	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/27 20:46
S18	17	S17 and buffer interleav\$5 bit	US-PGPUB; USPAT; USOCR;	SAME	OFF	2014/09/27 20:47

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S19	10	S18 and parity near4 bit	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/27 20:47
S20	7	S19 and rate near4 matching	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/27 20:48
S21	0	("20020051501" "6088387" "6028897" "6014411" "6044116" "6370669" "6397367" "6480503" "6553539" "6601214" "6621873" "6622281" "6665833" "6675348" "6697986" "6744744" "6807238" "6816556" "6829305" "6892342" "6903665" "7000173" "7000174" "7016427" "7016658" "7027782" "7072307" "7089480" "7114121" "7146552" "7165209" "7200792" "7210089" "7251285" "7280609" "7281189" "7283509" "7293217" "7415263" "7421033" "7421644" "7458011" "7475330" "7483389" "7496079" "7523383" "7536624" "7620872" "7640486" "7673213" "7676731" "7676732" "7734988" "7743312" RE41498 "7782973" "7802164" "7814390" "7814391" "7827466" "7827472" "7865813" "7925963" "7958425" "7987414" "8028223" "8042028" "8074143" "7865813" "7925963" "7958425" "7987414" "8028223" "8042028" "8074143" "8112697" "8140950" "8181099" "8234557" "8250429" "8254284" "8275032" "8352840" "8359520" "8386877" "8386902" "8392808" "8416794" "8458579" "8489959" "8504887" "8527856" "8595590" "8681705" "8726137" "8750256" "8788920" "20010009569" "20010010710" "20010034209").pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	SAME	OFF	2014/09/27 20:50
S22	272	("20020051501" "6088387" "6028897" "6014411" "6044116" "6370669" "6397367" "6480503" "6553539" "6601214" "6621873" "6622281" "6665833" "6675348" "6697986" "6744744" "6807238" "6816556" "6829305" "6892342" "6903665" "7000173" "7000174" "7016427" "7016658" "7027782" "7072307" "7089480" "7114121" "7146552" "7165209" "7200792" "7210089"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2014/09/27 20:51

EAST Search History

		"7251285" "7280609" "7281189" "7283509" "7293217" "7415263" "7421033" "7421644" "7458011" "7475330" "7483389" "7496079" "7523383" "7536624" "7620872" "7640486" "7673213" "7676731" "7676732" "7734988" "7743312" RE41498 "7782973" "7802164" "7814390" "7814391" "7827466" "7827472" "7865813" "7925963" "7958425" "7987414" "8028223" "8042028" "8074143" "7865813" "7925963" "7958425" "7987414" "8028223" "8042028" "8074143" "8112697" "8140950" "8181099" "8234557" "8250429" "8254284" "8275032" "8352840" "8359520" "8386877" "8386902" "8392808" "8416794" "8458579" "8489959" "8504887" "8527856" "8595590" "8681705" "8726137" "8750256" "8788920" "20010009569" "20010010710" "20010034209").pn.				
S23	2	S20 and S22	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2014/09/27 20:52

9/ 30/ 2014 10:00:36 AM

C:\Users\falphonse\Documents\EAST\Workspaces\14300734.wsp

Search Notes 	Application/Control No. 14300734	Applicant(s)/Patent Under Reexamination PIETRASKI ET AL.
	Examiner FRITZ ALPHONSE	Art Unit 2112

CPC- SEARCHED		
Symbol	Date	Examiner
H03M 13/091	2/9/2015	FA

CPC COMBINATION SETS - SEARCHED		
Symbol	Date	Examiner
H03M 13/2771	2/9/2015	FA

US CLASSIFICATION SEARCHED			
Class	Subclass	Date	Examiner
714	755,786,490,752,701,800	2/9/2015	FA

SEARCH NOTES		
Search Notes	Date	Examiner
East Search	2/9/2015	FA
Plus Search (See East Search)	2/9/2015	FA

INTERFERENCE SEARCH			
US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner
H03M	13/2957	2/5/2015	FA

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<i>Index of Claims</i> 	Application/Control No. 14300734	Applicant(s)/Patent Under Reexamination PIETRASKI ET AL.
	Examiner FRITZ ALPHONSE	Art Unit 2112

✓	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	09/30/2014	02/05/2015						
	1	✓	=						
	2	✓	=						
	3	✓	=						
	4	✓	=						
	5	✓	=						
	6	✓	=						

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)

Electronically filed on May 14, 2015

24374 7590 02/17/2015
VOLPE AND KOENIG, P.C.
DEPT. ICC
UNITED PLAZA
30 SOUTH 17TH STREET
PHILADELPHIA, PA 19103

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.
14/300,734	06/10/2014	Philip J. Pietraski	I-2-0526US06	1001

TITLE OF INVENTION: DETECTION, AVOIDANCE AND/OR CORRECTION OF PROBLEMATIC PUNCTURING PATTERNS IN PARITY BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	\$960	\$0	\$0	\$960	05/18/2015

EXAMINER	ART UNIT	CLASS-SUBCLASS
ALPHONSE, FRITZ	2112	714-755000

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 Volpe and Koenig, P.C.

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)

InterDigital Technology Corporation

Wilmington, DE

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 09-0435 (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 /Jeffrey M. Glabicki/

Date May 14, 2015

Typed or printed name Jeffrey M. Glabicki

Registration No. 42,584

Electronic Patent Application Fee Transmittal				
Application Number:		14300734		
Filing Date:		10-Jun-2014		
Title of Invention:		DETECTION, AVOIDANCE AND/OR CORRECTION OF PROBLEMATIC PUNCTURING PATTERNS IN PARITY BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES		
First Named Inventor/Applicant Name:		Philip J. Pietraski		
Filer:		Jeffrey M. Glabicki/Peggy Ferello		
Attorney Docket Number:		I-2-0526US06		
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	960	960

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				960

Electronic Acknowledgement Receipt	
EFS ID:	22347057
Application Number:	14300734
International Application Number:	
Confirmation Number:	1001
Title of Invention:	DETECTION, AVOIDANCE AND/OR CORRECTION OF PROBLEMATIC PUNCTURING PATTERNS IN PARITY BIT STREAMS USED WHEN IMPLEMENTING TURBO CODES
First Named Inventor/Applicant Name:	Philip J. Pietraski
Customer Number:	24374
Filer:	Jeffrey M. Glabicki/Peggy Ferello
Filer Authorized By:	Jeffrey M. Glabicki
Attorney Docket Number:	I-2-0526US06
Receipt Date:	14-MAY-2015
Filing Date:	10-JUN-2014
Time Stamp:	15:35:28
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	Deposit Account
Payment was successfully received in RAM	\$ 960
RAM confirmation Number	1952
Deposit Account	090435
Authorized User	GLABICKI, JEFFREY M.

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

Charge any Additional Fees required under 37 C.F.R. Section 1.17 (Patent application and reexamination processing fees)

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)	I_2_0526US06_Issue_Fee_2015 0514.PDF	107368 436bb50cea42b76118f67218c98a43d67b390a1b	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	31032 b5fce3598298938909802cfff049d4068377472b	no	2
Warnings:					
Information:					
Total Files Size (in bytes):			138400		
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.					



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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/300,734	06/23/2015	9065486	I-2-0526US06	1001

24374 7590 06/03/2015
VOLPE AND KOENIG, P.C.
DEPT. ICC
UNITED PLAZA
30 SOUTH 17TH STREET
PHILADELPHIA, PA 19103

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):

Philip J. Pietraski, Jericho, NY;
InterDigital Technology Corporation, Wilmington, DE;
Gregory S. Sternberg, Mt. Laurel, NJ;

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AO 120 (Rev. 08/10)

TO: Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
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In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court for the Eastern District of Texas, Texarkana Division on the following

☐ Trademarks or ☒ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO. 5:22-CV-00113	DATE FILED 9/2/2022	U.S. DISTRICT COURT for the Eastern District of Texas, Texarkana Division
PLAINTIFF PANTECH CORPORATION and PANTECH WIRELESS, LLC		DEFENDANT LG ELECTRONICS INC., and LG ELECTRONICS U.S.A., INC.
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 9,136,924	9/15/2015	Pantech Corporation
2 9,854,545	12/26/2017	Pantech Corporation
3 10,869,247	12/15/2020	Pantech Wireless
4 9,313,809	4/12/2016	Pantech Wireless
5 9,065,486	6/23/2015	Pantech Wireless

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY		
	☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading		
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK	
1			
2			
3			
4			
5			

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT		
CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
 Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

AO 120 (Rev. 08/10)

TO: Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
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PLAINTIFF PANTECH CORPORATION and PANTECH WIRELESS, LLC		DEFENDANT LG ELECTRONICS INC., and LG ELECTRONICS U.S.A., INC.
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 7,283,839	10/16/2007	Pantech Corporation
2 9,575,631	2/21/2017	Pantech Corporation
3		
4		
5		

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY	
	☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
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DECISION/JUDGEMENT		
CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
 Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy