

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of: Taichi Majima
U.S. Patent No.: 7,804,891 Attorney Docket No. 50095-0246IP1
Issue Date: September 28, 2010
Appl. Serial No.: 10/594,985
Filing Date: September 29, 2006
Title: DEVICE AND METHOD FOR JUDGING COMMUNICATION
QUALITY AND PROGRAM USED FOR THE JUDGMENT

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**PETITION FOR *INTER PARTES* REVIEW OF UNITED STATES PATENT
NO. 7,804,891 PURSUANT TO 35 U.S.C. §§ 311–319, 37 C.F.R. § 42**

TABLE OF CONTENTS

I.	REQUIREMENTS FOR IPR	1
A.	Grounds for Standing	1
B.	Challenge and Relief Requested	1
II.	SUMMARY OF THE '891 PATENT	2
A.	Brief Description	2
B.	Prosecution History	5
III.	LEVEL OF ORDINARY SKILL	5
IV.	CLAIM CONSTRUCTION	6
A.	“data to be transmitted” (all claims)	7
B.	Means-Plus-Function Elements (Claim 1)	11
	1. “symbol judging means” (Element [1a])	12
	2. “communication quality judging means” (Elements [1b], [1e])	12
	3. “data changing means” (Element [1c])	13
	4. “means for externally obtaining a parameter that defines at least a portion of the condition” (Claim [2])	15
V.	DETAILED EXPLANATION OF GROUNDS	15
A.	GROUND 1A: Obviousness Based on Yamane-Mizuki-Matsumoto (Claims 1, 3, 8, 9)	15
	1. Yamane	15
	2. Mizuki	16
	3. Matsumoto	18

4.	The Yamane-Mizuki-Matsumoto Combination	19
5.	Application to Challenged Claims.....	26
B.	GROUND 1B: Obviousness Based on Yamane-Mizuki-Matsumoto-Lagerqvist (Claims 1, 3-9)	53
1.	Lagerqvist.....	53
2.	The Yamane-Mizuki-Matsumoto-Lagerqvist Combination.....	54
3.	Application to Challenged Claims.....	58
C.	GROUND 1C: Obviousness Based on Yamane-Mizuki-Matsumoto-Kaplan (Claim 2).....	74
1.	Kaplan	74
2.	The Yamane-Mizuki-Matsumoto-Kaplan Combination.....	74
3.	Application to Challenged Claims.....	75
VI.	INSTITUTION SHOULD NOT BE DENIED ON DISCRETION.....	77
VII.	CONCLUSION AND PAYMENT OF FEES.....	77
VIII.	MANDATORY NOTICES UNDER 37 C.F.R. § 42.8(a)(1).....	77
A.	Real Party-In-Interest Under 37 C.F.R. § 42.8(b)(1)	77
B.	Related Matters Under 37 C.F.R. § 42.8(b)(2)	77
C.	Lead And Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3)	78
D.	Service Information.....	78

LIST OF EXHIBITS

EX1001	U.S. Patent No. 7,804,891 to Majima (“the ’891 Patent”)
EX1002	Excerpts from the Prosecution History of the ’891 Patent (“the Prosecution History”)
EX1003	Expert Declaration and Curriculum Vitae of David Lett
EX1004	JP Publication No. JPH05260021A and Certified English Translation (“Yamane”)
EX1005	U.S. Patent No. 6,512,748 (“Mizuki”)
EX1006	U.S. Patent No. 5,425,053 (“Matsumoto”)
EX1007	U.S. Patent No. 5,502,713 (“Lagerqvist”)
EX1008	U.S. Patent No. 6,456,831 (“Tada”)
EX1009	U.S. Patent No. 6,232,906 (“Tada-906”)
EX1010	Design of a Robust Baseband LPC Coder for Speech Transmission over 9.6 Kbit/s Noisy Channels (1982), <i>available at</i> https://ieeexplore.ieee.org/document/1095525
EX1011	Stefanovic, <i>Vocoder Model based Variable Rate Narrowband and Wideband Speech Coding below 9kbps</i> (1999), <i>available at</i> https://www.proquest.com/docview/1814373345?%20Theses&fromopenview=true&pq-origsite=gscholar&sourcetype=Dissertations%20
EX1012	U.S. Patent No. 5,432,778 (“Minde”)
EX1013	U.S. Patent No. 6,519,740 (“Martensson”)

- EX1014 Complaint, *Advanced Coding Technologies LLC v. Apple Inc.*, 2-24-cv-00687, E.D. Tex., filed Aug. 20, 2024
- EX1015 Patent Owner’s Infringement Chart for the ’891 Patent, *Advanced Coding Technologies LLC v. Apple Inc.*, 2-24-cv-00687, E.D. Tex., filed Aug. 20, 2024
- EX1016 U.S. Patent Application Publication No. 2004/0203941 (“Kaplan”)
- EX1017 Newaskar, *A/D Precision Requirements for an Ultra-Wideband Radio Receiver* (1999), available at https://web.archive.org/web/20170810194425id_/http://www-mtl.mit.edu/researchgroups/icsystems/uwb/docs/SIPS_2002_A_DC_resolution.pdf
- EX1018 U.S. Patent No. 6,184,829 (“Stilp”)
- EX1019 Landau, *Sampling, Data Transmission, and the Nyquist Rate*, Proceedings of the IEEE, Vol. 55, No. 10 (Oct. 1967)

LIST OF CHALLENGED CLAIM ELEMENTS

Claim 1	
[1pre]	A communication quality judging device comprising:
[1a]	a symbol judging means for obtaining a baseband signal representative of a sequence of multilevel symbols and judging the symbol represented by the baseband signal;
[1b]	a communication quality judging means for judging communication quality of a transmission channel over which the baseband signal has been transmitted, based on content of the symbol judged by the symbol judging means; and
[1c]	a data changing means for, if the communication quality judged by the communication quality judging means does not satisfy a predetermined condition, making a predetermined change to the data to be transmitted represented by the symbol used in the judgment,
[1d]	wherein at least a portion of a bit string is distinguished as a protected portion, the bit string constituting data to be transmitted represented by the sequence of symbols, and at least a portion of the symbol that belongs to the sequence of symbols contains a bit belonging to the protected portion and a redundant bit having a predetermined value, and
[1e]	wherein the communication quality judging means identifies the number of redundant bits having the predetermined value or the number of redundant bits missing the predetermined value among the redundant bits contained in the symbol that contains a bit belonging to the protected portion, and judges the communication quality of the transmission channel based on the identified result.
Claim 2	
[2]	The communication quality judging device according to claim 1, wherein the data changing means comprises means for externally obtaining a parameter that defines at least a portion of the condition.

Claim 3	
[3]	The communication quality judging device according to claim 1 or 2, wherein the predetermined change includes a process of substantially destroying the data to be transmitted represented by the symbol used to judge that the communication quality does not satisfy a predetermined condition.
Claim 4	
[4]	The communication quality judging device according to claim 1 or 2, wherein the predetermined change includes a process of replacing the data to be transmitted represented by the symbol used to judge that the communication quality does not satisfy a predetermined condition, with previous data represented by a symbol previously obtained by the symbol judging means.
Claim 5	
[5]	The communication quality judging device according to claim 4, wherein the predetermined change further includes a process of substantially destroying the data to be transmitted that follows last replaced data and that is represented by the symbol used to judge that the communication quality does not satisfy a predetermined condition, when more than a predetermined number of replaced data continues.
Claim 6	
[6]	The communication quality judging device according to claim 1 or 2, wherein the data to be transmitted is composed of data representative of strength of a variable, and the predetermined change includes an attenuating process of changing the data to be transmitted represented by the symbol used to judge that the communication quality does not satisfy a predetermined condition, to a data equivalent in which the variable represented by the data is attenuated.

Claim 7	
[7]	The communication quality judging device according to claim 6, wherein, when first data, which is transmitted immediately before second data to be subjected to the attenuating process, has been subjected to the attenuating process, the attenuating process provided to the second data consists of a process of changing the second data to a data equivalent in which the variable represented by the second data is attenuated at an attenuation ratio larger than that for the variable represented by the first data.
Claim 8	
[8pre]	A communication quality judging method, the method comprising the steps of:
[8a]	obtaining a baseband signal representative of a sequence of multilevel symbols and judging the symbol represented by the baseband signal;
[8b]	judging communication quality of a transmission channel over which the baseband signal has been transmitted, based on content of the symbol judged in the symbol judging step; and
[8c]	changing data if the communication quality judged in the communication quality judging step does not satisfy a predetermined condition, to make a predetermined change to the data to be transmitted represented by the symbol used in the judgment,
[8d]	wherein at least a portion of a bit string is distinguished as a protected portion, the bit string constituting data to be transmitted represented by the sequence of symbols, and at least a portion of the symbol that belongs to the sequence of symbols contains a bit belonging to the protected portion and a redundant bit having a predetermined value, and

[8e]	wherein, in the communication quality judging step, the number of redundant bits having the predetermined value or the number of redundant bits missing the predetermined value is identified among the redundant bits contained in the symbol that contains a bit belonging to the protected portion, and the communication quality of the transmission channel is judged based on the identified result.
Claim 9	
[9pre]	A computer program causing a computer to execute the steps of:
[9a]	obtaining a baseband signal representative of a sequence of multilevel symbols and judging the symbol represented by the baseband signal;
[9b]	judging communication quality of a transmission channel over which the baseband signal has been transmitted, based on content of the symbol judged in the symbol judging step; and
[9c]	changing data if the communication quality judged in the communication quality judging step does not satisfy a predetermined condition, to make a predetermined change to the data to be transmitted represented by the symbol used in the judgment,
[9d]	wherein at least a portion of a bit string is distinguished as a protected portion, the bit string constituting data to be transmitted represented by the sequence of symbols, and at least a portion of the symbol that belongs to the sequence of symbols contains a bit belonging to the protected portion and a redundant bit having a predetermined value, and
[9e]	wherein, in the communication quality judging step, the number of redundant bits having the predetermined value or the number of redundant bits missing the predetermined value is identified among the redundant bits contained in the symbol that contains a bit belonging to the protected portion, and the communication quality of the transmission channel is judged based on the identified result.

Apple Inc. (“Apple” or “Petitioner”) petitions for *Inter Partes* Review (“IPR”) of claims 1-9 (“the Challenged Claims”) of U.S. Patent No. 7,804,891 (“the ’891 Patent”).

I. REQUIREMENTS FOR IPR

A. Grounds for Standing

Petitioner certifies that the ’891 Patent is available for IPR. This Petition is being filed within one year of service of a complaint against Apple. *See* EX1014. Apple is not barred or estopped from requesting review of the Challenged Claims on the grounds identified below.

B. Challenge and Relief Requested

Apple requests institution of IPR and cancellation of the Challenged Claims based on the following grounds:

Ground	Claims	Basis
1A	1, 3, 8, 9	§103 – Obvious based on Yamane (EX1004) in view Mizuki (EX1005) and Matsumoto (EX1006)
1B	1, 3-9	§103 – Obvious based on Yamane in view Mizuki, Matsumoto, and Lagerqvist (EX1007)
1C	2	§103 – Obvious based on Yamane in view Mizuki, Matsumoto, and Kaplan (EX1016)

Grounds 1A-1C are further supported by the expert declaration of David Lett (EX1003), and the additional evidence cited herein.

The '891 Patent is a U.S. National Stage entry of a PCT application filed on March 30, 2005, claiming priority to a Japanese patent application filed March 31, 2004. Without conceding that the '891 Patent is entitled to the benefit of the Japanese application's filing date, Petitioner nonetheless treats March 31, 2004 as the Critical Date of the Challenged Claims for purposes of the analysis in this Petition. Grounds 1A-1C are based on patents or printed publications that all qualify as prior art under pre-AIA 35 U.S.C. §102(b) as shown below:¹

Reference	Pre-AIA Prior Art Status
Yamane	pre-AIA §102(b) – Published on Oct. 8, 1993
Mizuki	pre-AIA §102(b) – Patented on Jan. 28, 2003
Matsumoto	pre-AIA §102(b) – Patented on Jun. 13, 1995
Lagerqvist	pre-AIA §102(b) – Patented on Mar. 26, 1996
Kaplan	pre-AIA §102(e) – Filed on April 11, 2002

II. SUMMARY OF THE '891 PATENT

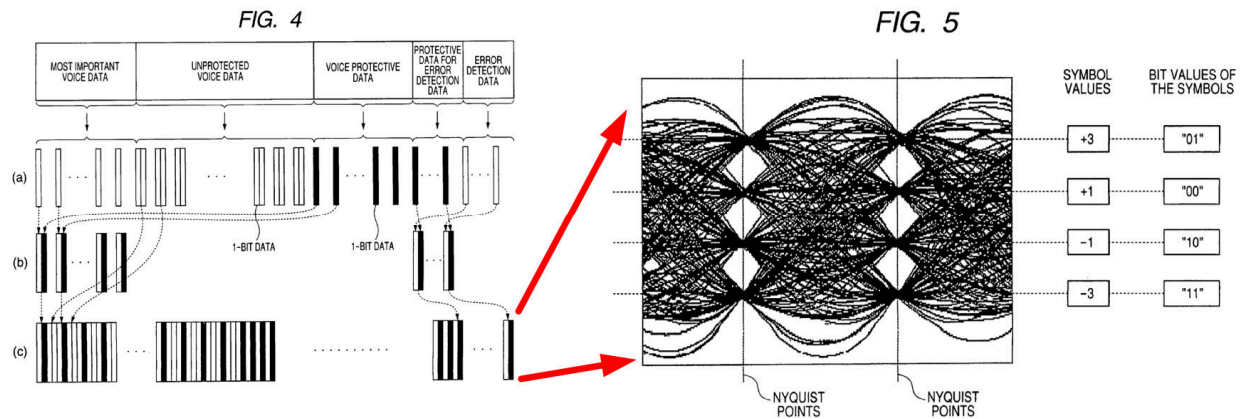
A. Brief Description

The '891 Patent describes techniques for encoding voice data and modulating the encoded signals for transmission to a receiver. EX1001, 1:14-2:44, 2:48-4:29, 5:38-7:40, FIGS. 1-4; EX1003, ¶24. In an embodiment, the transmitter

¹ Yamane, Mizuki, Matsumoto, and Lagerqvist further qualify as prior art under §102(a), and all but Yamane further qualify as prior art under §102(e).

separates the voice data into groups including “most important” bits that are afforded a higher level of protection against transmission errors and “unprotected” bits that are afforded a lower level of protection. EX1001, 6:4-55, 8:27-55, 10:21-54, FIGS. 3-4. To prepare the voice data for transmission, the transmitter interleaves the most important bits of the voice data with “protective” bits that have a predetermined value (e.g., “1”) to create interleaved pairs consisting of a most important bit from the coded voice data and a protective bit of a predetermined value (e.g., “1”). EX1001, 5:59-6:15, 6:46-50, 6:66-7:31, FIGS. 3-4.

Each 2-bit pair corresponds to a different symbol in a four-value modulation scheme (e.g., frequency-shift keying (FSK)) that is used to transmit the voice data to a receiver over a noisy communication channel. EX1001, 7:17-40, FIG. 4. Noticeably, because a predetermined protective bit is paired with each most-important voice data bit, only two of the four transmission symbols can be used to represent a most-important voice data bit. EX1001, 7:41-8:3, FIG. 5. For example, as shown below in FIG. 5, the pairing of a most-important bit with a predetermined protective bit (e.g., “1”) means that the most-important bit can only be mapped to a +3 or -3 symbol depending on whether the value of the most-important bit is “1” or “0.” *Id.* These symbols provide maximum frequency separation in the disclosed 4-value FSK scheme. EX1001, 5:1-37, 7:41-8:47, FIG. 5; EX1003, ¶25.



EX1001, FIGS. 4-5 (annotated).

The transmitter then sends the modulated signal to a receiver. EX1001, 4:54-5:37, 8:56-9:12, FIG. 6. In addition to demodulating and decoding the signal, the receiver is also configured to judge a communication quality of the channel based on how many of the protective bits were decoded to the predetermined value (e.g., “1”) as expected versus how many of the protective bits were decoded to an incorrect value (e.g., “0”) that does not match the expected/predetermined value. EX1001, 9:13-67, FIG. 6. Based on comparing the values of the protective bits as received with an expected result, the receiver judges a communication quality of the transmission channel and takes one or more actions to change the voice data if the channel quality is significantly degraded. EX1001, 9:13-25, 10:5-12:28, FIGs. 6, 8; EX1003, ¶26-27.

B. Prosecution History

The Examiner issued just one Office Action during original examination of the '891 Patent. EX1002, 192-202. In this Office Action, the independent claims were rejected as obvious over Minde (EX1012) in view of Martensson (EX1013). EX1002, 192-202; EX1003, ¶29. The applicant responded by amending independent claim 1 to require “data changing means” that can make a “predetermined change to the data” when the judged communication quality “does not satisfy a predetermined condition.” EX1002, 212-220. This feature was originally recited in a dependent claim that the Examiner deemed allowable in the first Office Action. Independent claims 9 and 10 were amended to recite similar features. EX1002, 212-220. Following these amendments, the Examiner allowed the application and the '891 Patent was granted. EX1002, 224-227.

III. LEVEL OF ORDINARY SKILL

A person of ordinary skill in the art for the '891 Patent by the Critical Date (“POSITA”) would have had a Bachelor’s degree in electrical engineering, computer engineering, computer science, or equivalent, and two years of industry experience in telecommunications and audio coding. EX1003, ¶30-32. Additional education might compensate for less experience, and vice versa. EX1003, ¶30-32.

IV. CLAIM CONSTRUCTION

All claim terms should be construed according to the *Phillips* standard.

Phillips v. AWH Corp., 415 F.3d 1303 (Fed. Cir. 2005); 37 C.F.R. §42.100.

Petitioner submits that the claim elements listed below should be construed for purposes of this proceeding, and that the remaining claim terms do not require a formal construction for purposes of demonstrating that the claims are obvious based on Grounds 1A-1C in this Petition. *Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361 (Fed. Cir. 2011); *Google Inc. v. Intellectual Ventures II LLC*, 701 Fed. Appx. 946, 956 (Fed. Cir. 2017) (“do not require construction” for purposes of “resolv[ing] the parties’ patentability arguments”); EX1003, ¶33.

Petitioner reserves the right to respond to any constructions offered by Patent Owner or adopted by the Board. Petitioner is not conceding that each challenged claim satisfies all statutory requirements, nor is Petitioner waiving any arguments concerning indefiniteness or claim scope that can only be raised in district court or otherwise outside the context of an IPR. *Mylan Pharm. Inc. v. Horizon Pharma USA, Inc.*, IPR2018-00272, Paper 35, 6-8 (PTAB 2019). The Board has regularly compared indefinite claims to the prior art for purposes of considering unpatentability. *See, e.g., Chicago Mercantile Exchange, Inc. v. 5th Market, Inc.*, CBM2013-00027, Paper 33, 3 (PTAB 2014); *SAP America, Inc. v. Lakshmi Arunachalam*, CBM2013-00013, Paper 61, 29 (PTAB 2014). For this

Petition, Petitioner applies prior art in a manner consistent with disclosure of the claimed features in the '891 Patent or Patent Owner's allegations of infringement before the district court. *See* EX1015; EX1003, ¶33.

A. “data to be transmitted” (all claims)

Independent claims 1, 8, and 9 each recite limitations referring to “data to be transmitted.” EX1003, ¶34. In the context of the claims and specification of the '891 Patent, a POSITA would have understood the term “data to be transmitted” in the claims to encompass data that was to be transmitted by a transmitter and that has been received by a receiver. EX1003, ¶34. This interpretation is consistent with the logical structure of the claim and the specification of the '891 Patent.

For example, claim 1 recites the following components of a “communication quality judging device” in Elements [1a]-[1c]:

[1a] a symbol judging means for *obtaining a baseband signal representative of a sequence of multilevel symbols* and judging *the symbol represented by the baseband signal*;

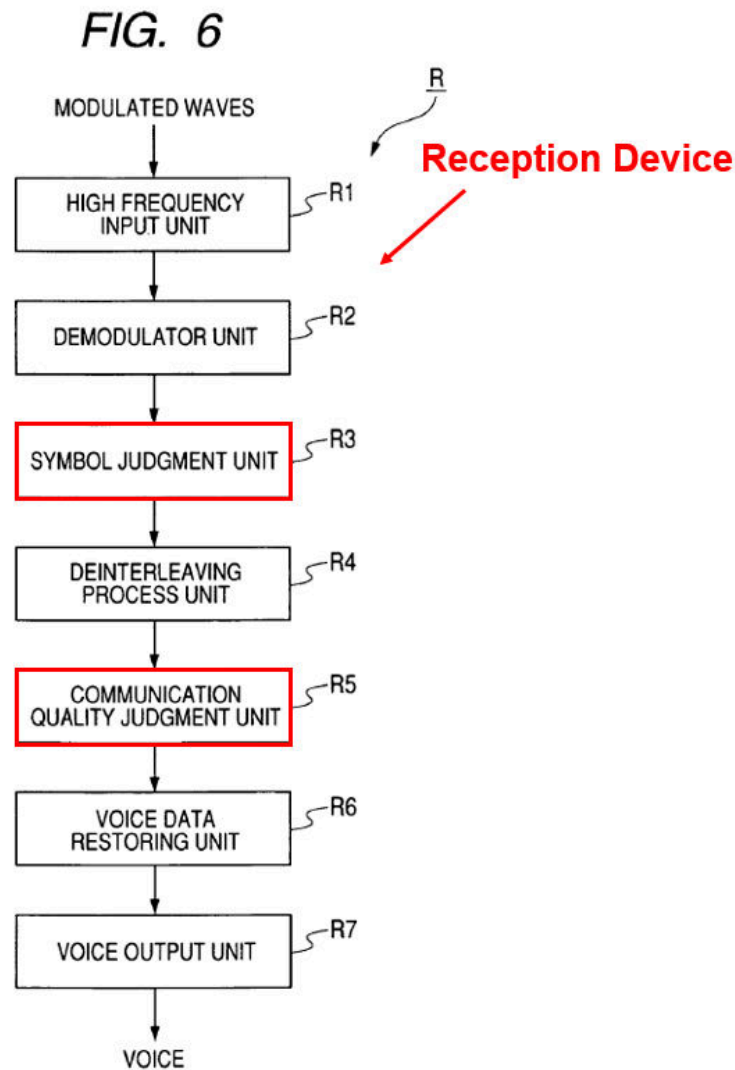
[1b] a communication quality judging means for judging communication quality of a transmission channel over which *the baseband signal has been transmitted*, based on content of the symbol judged by the symbol judging means; and

[1c] a data changing means for, if the communication quality judged by the communication quality judging means does not satisfy a predetermined condition, ***making a predetermined change to the data to be transmitted represented by the symbol*** used in the judgment, EX1001, 15:35-63 (emphasis added); EX1003, ¶35.

As shown above, in claim 1, the “data to be transmitted” is represented by a judged “symbol,” and the judged symbol is in turn represented by a “baseband signal [that] ***has been transmitted.***” *Id.* EX1003, ¶36. In other words, the “data to be transmitted” refers to data represented by a symbol in a baseband signal that ***has been transmitted*** by the time the communication quality judging device performs the functions recited in claim 1. EX1003, ¶36. This makes sense because the communication quality judging means is an element of the ***receiver*** that judges the communication quality of the transmission channel by evaluating bits in a ***transmitted*** signal. *Id.* Patent Owner has identified no description in the ’891 Patent for judging the quality of a channel based on data that has not yet been transmitted. EX1003, ¶¶36-37.

The specification of the ’891 Patent instead explicitly discloses the functions of judging symbols, judging communication quality, and changing data as functions performed by a “symbol judgment unit R3” and “communication quality judgment unit 5” of a “***reception device R.***” EX1001, 8:56-9:25, 9:36-10:9, 10:45-

12:10, FIG. 5; EX1003, ¶36-37. Even in the preferred embodiments of the '891 Patent, “obtaining a baseband signal,” “judging communication quality of a transmission channel,” and “making a predetermined change to the data to be transmitted” are each performed by a reception device (i.e., a receiver), using data that has already been transmitted from a transmission device. EX1003, ¶37. When the specification uses the term “data to be transmitted,” the term is used in the context of operations performed by the *transmitter* rather than the receiver as recited in claim 1. *See, e.g.*, EX1001 13:15-21, FIG. 2.



EX1001, FIG. 6 (annotated).

Independent claims 8 and 9 refer to “data to be transmitted” similarly to claim 1. Consequently, the claim term “data to be transmitted” should be interpreted to at least encompass data that was to be transmitted by a transmitter and that has been received by a receiver. EX1003, ¶38.

B. Means-Plus-Function Elements (Claim 1)

Elements [1a]-[1c] and [2] respectively recite “means for” performing functions without further recitation of structure.² EX1001, 15:35-63; EX1003, ¶39. As such, these claim elements “shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.” 35 U.S.C. §112(6); 37 C.F.R. §42.104(b)(3).

The specification of the '891 Patent explains that corresponding components of the reception device R, including the symbol judgement unit R3, communication quality judgement unit R5, and data restoring unit R6, are each “composed of a processor, a memory that stores a program executed by the processor, and the like.” EX1001, 9:13-25, 14:44-15:25. Because these components can be implemented with a general-purpose processor that executes “a program” stored in memory, the scope of Elements [1a]-[1c] encompass a processor configured to perform algorithm steps for carrying out the respective function(s) recited by each claim element and equivalents. *In re Aoyama*, 656 F.3d 1293, 1297 (Fed. Cir. 2011); *WMS Gaming, Inc. v. Int'l Game Tech.*, 184 F.3d 1339, 1349 (Fed. Cir. 1999); *In re Alappat*, 33 F.3d 1526, 1545 (Fed. Cir. 1994); EX1003, ¶40. The

² Element [1e] further describes the function performed by the “communication quality judging means” of Element [1b].

corresponding structure also encompasses “special purpose electronics” in lieu of a processor. EX1001, 13:1-4 (“any portion composed of a processor ... may be composed of a special purpose electronics instead of the processor”). EX1001, ¶40.

1. “symbol judging means” (Element [1a])

The recited function for the “symbol judging means” is “obtaining a baseband signal representative of a sequence of multilevel symbols and judging the symbol represented by the baseband signal.” EX1003, ¶41. The ’891 Patent discloses a “symbol judgment unit R3” of reception device R and its operation, for example, at col. 9:5-10:4 and FIG. 6. *See* EX1001, 9:5-10:4, FIG. 6; EX1003, ¶41. Based on the specification’s disclosure, the corresponding structure/algorithm for the “symbol judging means” encompasses special-purpose electronics or a general-purpose processor that performs the recited function by obtaining from a demodulator a baseband signal representative of a sequence of multilevel symbols and judging the symbol by comparing the symbol level to a set of thresholds, and equivalents thereof. EX1001, 9:13-25; EX1003, ¶42.

2. “communication quality judging means” (Elements [1b], [1e])

The recited function for the “communication quality judging means” is “judging communication quality of a transmission channel over which the baseband signal has been transmitted, based on content of the symbol judged by

the symbol judging means...[by] identif[ying] the number of redundant bits having the predetermined value or the number of redundant bits missing the predetermined value among the redundant bits contained in the symbol that contains a bit belonging to the protected portion.” EX1003, ¶43. The ’891 Patent discloses a “communication quality judgement unit R5” of reception device R and its operation, for example, at col. 10:45-12:10, 15:39-43, 15:56-63, and FIG. 6; *see also id.*, 6:46-50; EX1003, ¶43. Based on the specification’s disclosure, the corresponding structure/algorithm for the recited “communication quality judging means” encompasses special-purpose electronics or a processor configured to perform the recited function by evaluating the number of redundant bits x that do or do not have the predetermined value with respect to a predetermined lower limit n and a predetermined upper limit m (where n is an integer not less than 0, and m is an integer greater than n), and equivalents thereof. EX1003, ¶44.

3. “data changing means” (Element [1c])

The recited function for the “data changing means” is “if the communication quality judged by the communication quality judging means does not satisfy a predetermined condition, making a predetermined change to the data to be transmitted represented by the symbol used in the judgment.” EX1003, ¶45. The ’891 Patent discloses that the communication quality judgement unit R5 of the reception device R makes a predetermined change to the data if the communication

quality judged by the communication quality judging means does not satisfy a predetermined condition. EX1001, 11:7-34, 11:46-12:19, FIG. 6; EX1003, ¶45.

The '891 Patent describes several types of “predetermined change[s]” that can be made to the data under different conditions.³ For example, the data in a current frame can be “replaced” by data from one or more prior frames, the data in the current frame can be “attenuated,” or the data can be “destroyed” altogether depending on the judged quality of the communication channel and the history of changes made in prior frames. *See, e.g.*, EX1001, 11:26-12:10, 13:23-14:2, FIG. 8; EX1003, ¶46.

Based on the '891 Patent's disclosure, the corresponding structure/algorithm for the recited “data changing means” encompasses special-purpose electronics or a processor configured to perform the recited function by replacing, attenuating, or destroying data to be transmitted if the communication quality is judged not to satisfy a predetermined condition, and equivalents thereof. EX1003, ¶47.

³ The language of Element [1c] refers to just one “predetermined condition” and one “predetermined change.” Any one of the different types of predetermined changes to the data described in the specification of the '891 Patent is therefore within the scope of Element [1c]. EX1003, ¶46.

4. “means for externally obtaining a parameter that defines at least a portion of the condition” (Claim [2])

Claim 2 depends from claim 1 and adds that “the data changing means comprises means for externally obtaining a parameter that defines at least a portion of the condition.” EX1001, 15:63-67. The recited function for the additional “means for” limitation recited in claim 2 is “externally obtaining a parameter that defines at least a portion of the condition.” EX1003, ¶48. Based on the ’891 Patent’s disclosure, the corresponding structure/algorithm for the recited “means” encompasses a switch, a keyboard, a serial interface, other input devices, or a recording media drive device to externally obtain serially-transmitted parameters or to read parameters record on the recording media, and equivalents thereof. EX1001, 14:3-16; EX1003, ¶49.

V. DETAILED EXPLANATION OF GROUNDS

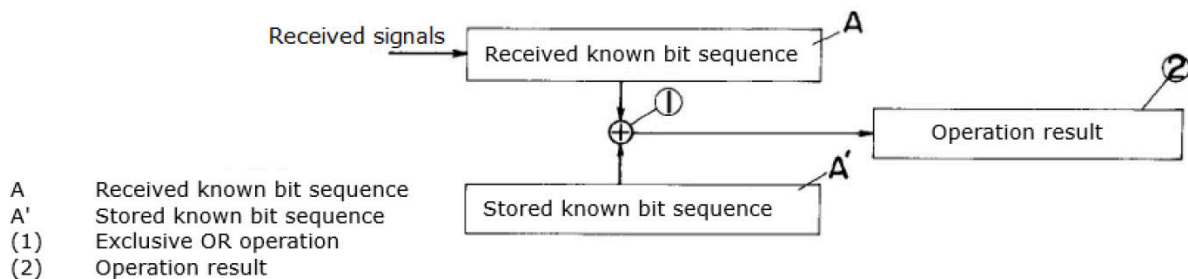
A. GROUND 1A: Obviousness Based on Yamane-Mizuki-Matsumoto (Claims 1, 3, 8, 9)

1. Yamane

Yamane describes a receiver that receives an information signal including a sequence of bits over a communication channel. EX1004, Abstract, [0002], [0005]-[0008], Cl. 1-3 EX1003, ¶50-51. The sequence of bits is appended with “known” bits that each have a predetermined value, much the same as embodiments of the ’891 Patent insert predetermined protective bits into the most important data.

EX1004, Abstract, [0002], [0007]-[0014], Cl. 1-3. The appended bits are referred to by Yamane as a “received known bit sequence A.” EX1004, Abstract, [0009], [0011]-[0013], FIG. 1. The receiver compares the received known bit sequence with a “stored known bit sequence A” to determine a quality of the communication channel over which the information signal is transmitted. EX1004. *Id.*

[FIG. 1]

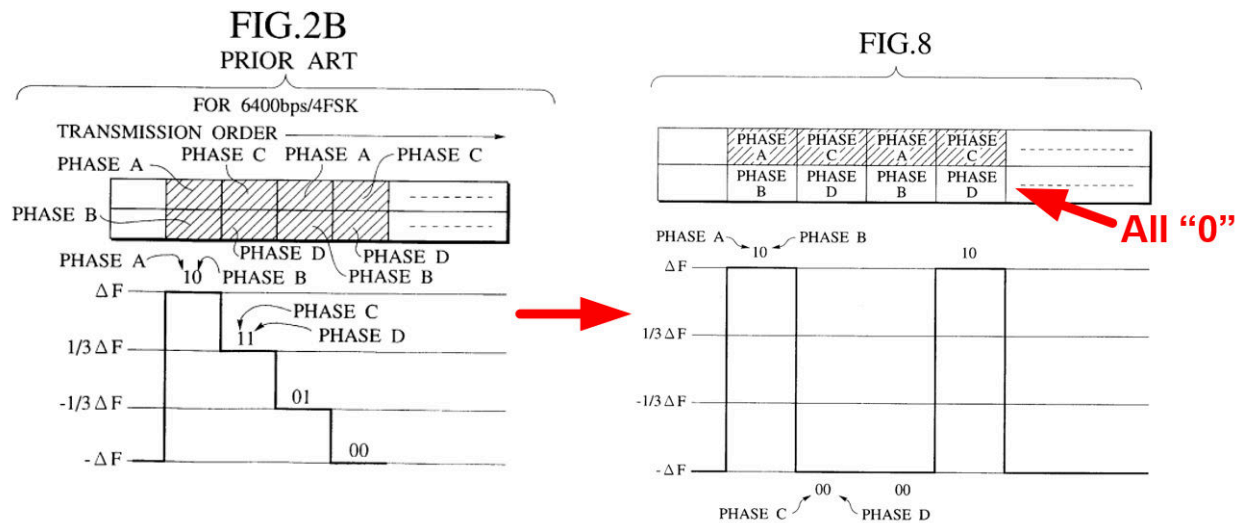


EX1004, FIG. 1.

2. Mizuki

Mizuki discloses a conventional radio paging scheme involving an FSK-modulated signal comprising a sequence of two-bit symbols, each symbol representing one bit from a first logical channel (also referred to as a “phase”) and another bit multiplexed from a second logical channel. EX1005, 1:22-2:27, FIG. 2B. The FSK scheme of Mizuki is nearly identical to the FSK scheme of the '891 Patent's preferred embodiment. EX1005, 1:22-2:27, FIG. 2B; *cf.* EX1001, 7:41-8:8, FIG. 5; EX1003, ¶52. For example, Mizuki explains that frequency shifts of

$+\Delta F$, $+\left(\frac{1}{3}\right)\Delta F$, $-\left(\frac{1}{3}\right)\Delta F$, and $-\Delta F$ correspond to the symbol bit values “10,” “11,” “01,” and “00,” respectively, much like the four states of the two-bit symbols (i.e., +3, +1, -1, -3) of the FSK scheme disclosed in the '891 Patent. EX1005, 1:22-2:27, 6:36-55, FIG. 2B; EX1001, FIG. 5.



EX1005, FIG. 2B, FIG. 8 (annotated).

Mizuki teaches that, in certain conditions, rather than multiplexing two data bits from different logical channels (phases) to form two-bit symbols, the two-bit symbols can be formed by pairing a single data bit from one logical channel with a redundant bit having a predetermined value. EX1005, 6:36-55, FIG. 8; EX1003, ¶53. When the predetermined value of the redundant bit is set to “0,” the two-bit symbols can assume just two values (i.e., “10” or “00”) that depend solely on the value of the single data bit and that correspond to maximally separated frequency shifts in the FSK-modulated signal of $(+\Delta F)$ or $(-\Delta F)$, while effectively

eliminating the intermediate frequency shifts $\left(+\left(\frac{1}{3}\right)\Delta F, -\left(\frac{1}{3}\right)\Delta F\right)$. *Id.* In Mizuki, therefore, consecutive symbols are “separated by the maximum signal-to-signal distance,” therefore leading to a situation where “errors due to influences such as thermal noises are less likely to occur.” EX1005, 1:63-2:37, 6:36-55, FIG. 2B, FIG. 8.

3. Matsumoto

Matsumoto discloses a “radio paging receiver” that receives a “multilevel modulated signal.” EX1006, 1:8-2:22, 2:41-3:15, FIGS. 1-2; EX1003, ¶54. For example, Matsumoto’s receiver includes an analog demodulator, and analog to digital (A/D) converter 13, and a multilevel-to-binary converter 14 to convert a modulated radio signal into a digital bit stream. EX1006, 2:41-3:25. Specifically, the A/D converter 13 “converts the time sequence of multilevel symbols into a time sequence of multilevel symbols having digital symbol levels, and the multilevel-to-binary converter “converts the time sequence of multilevel symbols into a binary (or digital) signal of binary (or digital) values by judging the symbol levels on the basis of judgement levels.” EX1006, 2:41-54, 3:16-25. This symbol judging is done by comparing measured symbol levels to threshold “judgment levels.” EX1006, 1:8-40, 3:16-25, 4:9-40, FIG. 2, *cf.* EX1001, 9:36-67.

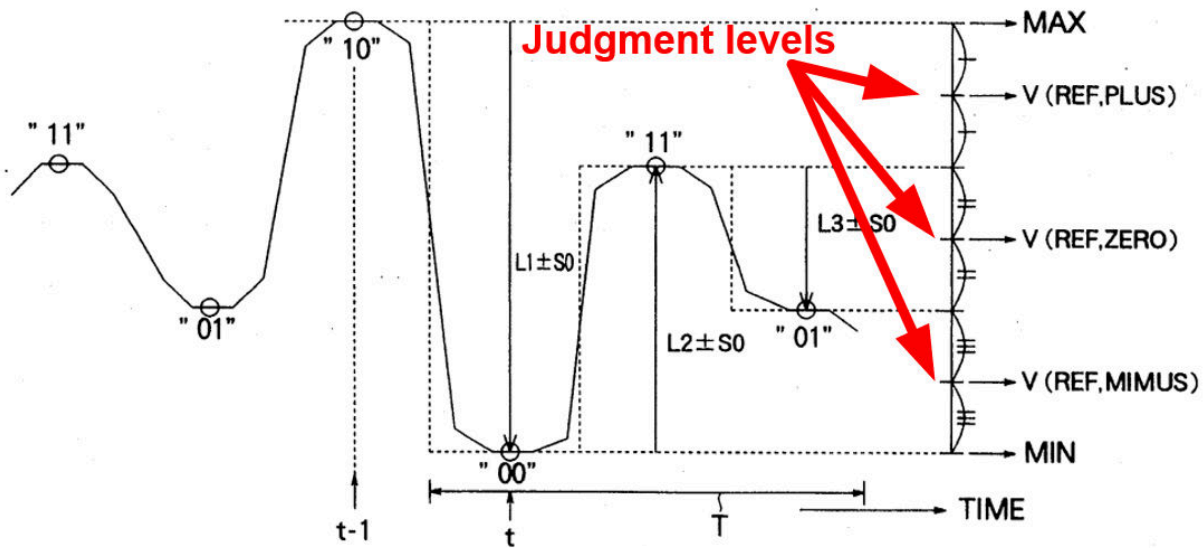


FIG. 2

EX1006, FIG. 2.

4. The Yamane-Mizuki-Matsumoto Combination

Obviousness of Integrating Mizuki's Teachings

As discussed above, Yamane discloses a receiver that (1) judges a quality of a communication channel by comparing a received bit sequence including predetermined redundant bits with a stored “known” bit sequence to count the number of “error bits” in the received sequence that do not match the known sequence and (2) selects an “error control method” based on the number of error bits. EX1004, [0002]-[0004], [0007], [0009]-[0020] *supra*, §V.A.1; EX1003, ¶55. Although Yamane mentions frame synchronization, Yamane is otherwise silent regarding any modulation and coding scheme that would be used to generate and

transmit frames comprised of the known bit sequence and encoded information signals. EX1003, ¶55. A POSITA therefore would have turned to references like Mizuki that describe details of known techniques for transmitting information signals along with redundant bits having known values. *Supra*, §V.A.2. For example, based on Mizuki, it would have been obvious to a POSITA to assign a single/fixed value to each bit in Yamane's known bit sequence (e.g., "0"), and to pair the known bit having the predetermined value (e.g., "0") with data bits from at least a portion of Yamane's BCH-encoded information signal B to form two-bit multilevel symbols that map to just two of four possible values (e.g., "10", "00") corresponding to maximally separated frequency shifts in an FSK modulation scheme.⁴ *Id.*; EX1005, 1:22-2:28, 6:37-50; EX1003, ¶55. Multiple reasons would have prompted a POSITA to integrate Mizuki's teachings in Yamane as described.

First, a POSITA would have sought to implement Yamane according to Mizuki's modulation scheme to enable the system to flexibly, and with low overhead, increase or decrease transmission rates depending on transmission needs by either assigning a known redundant bit to each two-bit symbol or assigning a

⁴ Yamane's BCH encoding is an example of well-known error correction coding as described by the '891 Patent. EX1001, 13:7-14.

second data bit to each two-bit symbol. EX1005, 7:19-29, 8:22-32, 3:1-28;
EX1003, ¶56.

Second, when the system employs a higher-data rate that uses all four symbol levels, the frequency shift levels for the symbols are set to $+\Delta F$, $+\left(\frac{1}{3}\right)\Delta F$, $-\left(\frac{1}{3}\right)\Delta F$, and $-\Delta F$, as taught by Mizuki. EX1005, 1:63-2:9, 6:36-50, FIG. 2B, FIG. 8. With a constant difference between neighboring levels of $\left(\frac{2}{3}\right)\Delta F$, a POSITA would have understood this to be beneficial for minimizing symbol judgement error. *Id.* For example, because no two neighboring levels are closer to each other than any other pair of neighboring levels, no neighboring symbol is more likely to be misjudged as compared with other neighboring symbols. EX1003, ¶57.

Third, a POSITA would have recognized that creating a modulated signal where each symbol includes an information bit and a redundant bit having the same predetermined value, as taught by Mizuki, would ensure that every information bit protected with a redundant bit is separated by a maximum signal-to-signal distance in a 4-valued FSK modulation scheme, and therefore decrease a symbol judgement error rate. EX1005, 2:9-16, 6:36-50, FIG. 2B, FIG. 8; EX1003, ¶58. For example, Mizuki teaches that when the least-significant bit in every symbol is set to the predetermined value of “0,” this ensures that every symbol is

the maximum phase $+\Delta F$ or the minimum phase $-\Delta F$ while eliminating the intermediate phases $\left(+\left(\frac{1}{3}\right)\Delta F, -\left(\frac{1}{3}\right)\Delta F\right)$, thus increasing a phase separation between differing consecutive symbols. EX1005, 8:36-50 (“the modulated signals take only two states ... that are separated by the maximum signal-to-signal distance”), 8:22-32 (“improve the reception characteristic of the receiver”), 2:10-17 (“errors due to influences such as thermal noises are less likely to occur”); FIGS. 7-8; EX1003, ¶58.

Fourth, a POSITA would have combined Yamane’s system for determining a quality of a transmission channel by counting a number of incorrect predetermined bits according with Mizuki’s suggestion to pair predetermined bits with protected information bits, because doing so would provide a convenient way to measure an error rate of the information channel. EX1003, ¶59.

Fifth, a POSITA would have found it obvious to combine the teachings of Yamane with Mizuki because the combination merely involves the application of a known technique to a known system to achieve predictable results. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007) (a supposed invention that “simply arranges old elements with each performing the same function it had been known to perform” is obvious). “It’s enough... to show that there was a known problem... in the art, that [another known teaching] ... helped address that issue, and that

combining the teachings of ... wasn't beyond the skill of an ordinary artisan.

Nothing more is required to show a motivation to combine under *KSR*.” *Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1380-81, (Fed. Cir. 2023). Here, Mizuki recognized a problem with existing modulation schemes and described a straightforward technique to address it. In this context, combining the teachings of Yamane and Mizuki would have been obvious and a POSITA would have reasonably expected success, especially since the combination involves well-known FSK modulation and standard radio hardware/software that was well known before the Critical Date. *KSR* at 401; EX1003, ¶60.

Obviousness of Integrating Matsumoto's Teachings

As described above, it would have been obvious based on Mizuki to form two-bit multilevel symbols in Yamane's system for modulation by frequency shift keying. EX1003, ¶61. Mizuki explains that “[t]he receiver can receive, demodulate and decode” received bit sequences, but neither Yamane nor Mizuki describe in detail the hardware or operations involved in de-modulating such multilevel symbols. A POSITA therefore would have turned to Matsumoto for specific guidance on implementing this aspect of the receiver. EX1003, ¶61. For example, Matsumoto describes how to judge multilevel symbols by comparing measured symbol values to threshold judgement levels and selecting one of four different bit pair values based on this comparison. EX1006, 3:16-25, 4:9-64, FIG. 2 *supra*,

§V.A.3. A POSITA would have further combined the teachings of Yamane-Mizuki with Matsumoto in this manner for multiple reasons. EX1003, ¶61.

First, a POSITA would have implemented the combination because comparing symbol measurements to judgement levels, as taught by Matsumoto, beneficially enables more accurate judgments of received symbols in a multilevel modulated signal. EX1003, ¶62. For example, Matsumoto explains that each symbol judgment corresponds to a range of judgement values (i.e., between $V(\text{ref}, \text{zero})$ and $V(\text{ref}, \text{plus})$ for the symbol “11”), meaning that the receiver could still correctly judge a symbol even when the symbol level deviates within a defined range from the nominal or expected symbol level. EX1006, 2:41-4:36; EX1003, ¶62.

Second, a POSITA would have been motivated to implement Yamane’s techniques for judging communication quality based on digital bit values and Mizuki’s techniques for transmitting an analog radio signal including a sequence of multilevel symbols with Matsumoto’s receiver, because doing so would beneficially provide an analog-to-digital converter for converting the analog radio signal into digital values for further processing. EX1003, ¶63.

Third, because Mizuki describes sequence symbols that each include two bits modulated according to a 4-valued FSK modulation mode, and Matsumoto describes techniques for converting an analog radio signal including multilevel

modulated symbols into digital bit values, a POSITA would have recognized Matsumoto's symbol judging technique to be an effective manner of resolving bits represented in a multi-level symbol. EX1005, 1:22-2:28, 6:37-7:14; EX1006, 2:41-4:36; EX1003, ¶64.

Fourth, a POSITA would have implemented the combination because Matsumoto's symbol judging technique would beneficially allow the resulting "radio communication apparatus ... [to] quickly recover from a misjudgment state." EX1006, 1:43-45; *see also id.*, 1:8-40 (describing problems perceived with other conventional approaches to symbol judgment); EX1003, ¶65.

Fifth, a POSITA would have found it obvious to further combine the teachings of Yamane with Matsumoto because the combination merely involves the application of a known technique to a known system to achieve predictable results. *KSR*, 550 U.S. at 417 (a supposed invention that "simply arranges old elements with each performing the same function it had been known to perform" is obvious). "It's enough... to show that there was a known problem... in the art, that [another known teaching] ... helped address that issue, and that combining the teachings of ... wasn't beyond the skill of an ordinary artisan. Nothing more is required to show a motivation to combine under *KSR*." *Intel*, 61 F.4th at 1380-81. Here, Matsumoto recognized a problem with existing symbol judging techniques and described a straightforward method to address it. In this context, combining

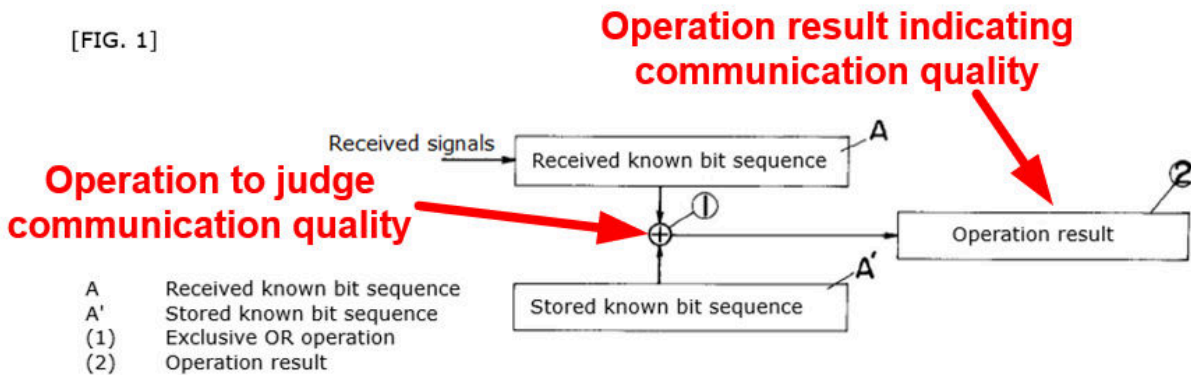
the teachings of Yamane-Mizuki with Matsumoto would have been obvious, and a POSITA would have reasonably expected success considering that the combination merely involves techniques that were established long before the Critical Date of the '891 Patent. *KSR* at 401; EX1003, ¶66.

5. Application to Challenged Claims

The Yamane-Mizuki-Matsumoto combination renders obvious claims 1, 3, 8, and 9 and their constituent elements for the reasons addressed in detail below. EX1003, ¶67.

Element [1pre]

To the extent the preamble is a limitation, the Yamane-Mizuki-Matsumoto combination renders obvious the claimed “communication quality judging device.” EX1003, ¶67. For example, Yamane discloses a receiver in a communication system that receives signals including information bit sequences appended with known bit sequences. EX1004, [0007]-[0020], [0005], [0006], Cl. 1-3. The receiver compares the received known bit sequence appended to a signal with a stored known bit sequence to determine a number of “error bits” in the known bit sequence that do not match the stored known bit sequence. EX1004, [0007], [0009]-[0013]. Based on the number of error bits, the receiver determines an “operation result” to judge the quality of the communication channel. EX1004, [0011], [0012], [0015]-[0018], FIG. 1



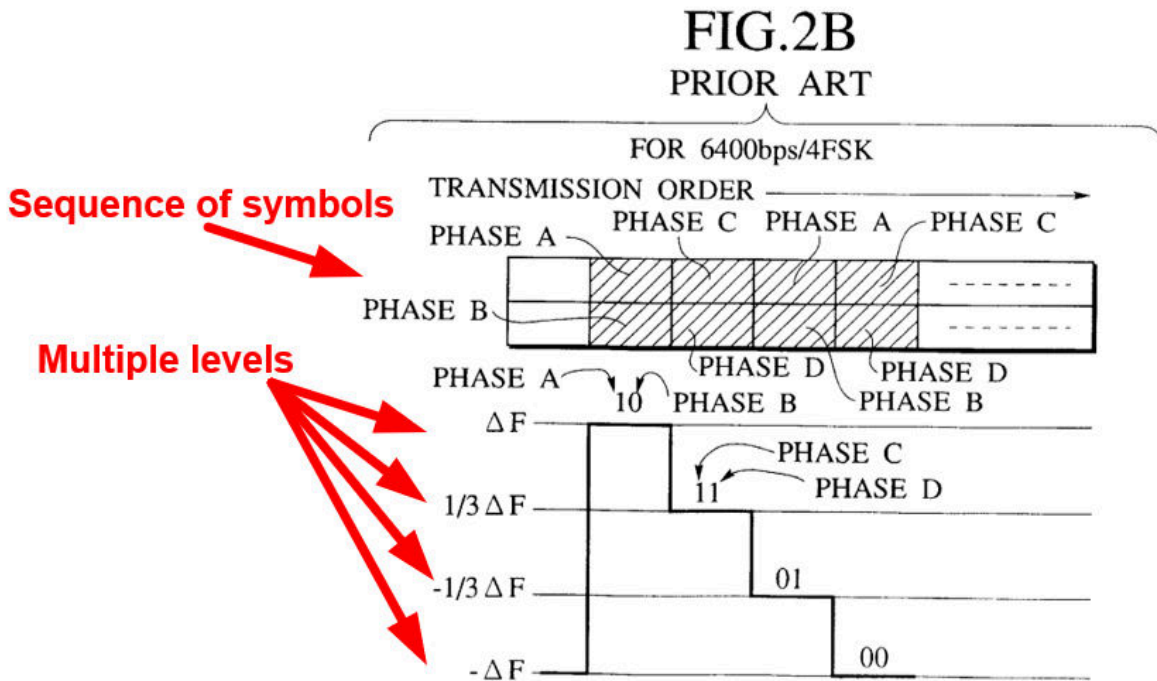
EX1004, FIG. 1 (annotated).

Referring to the techniques for counting error bits, Yamane explains that “the characteristics of a communication channel are deemed to be good when the value of this count result is small, and conversely, bad when the value is large,” which means that Yamane’s system determines that the operation result indicates good *quality* when relatively fewer error bits are counted and indicates poor *quality* when relatively more error bits are counted. EX1004, [0013], *see also id.*, [0001]-[0003], [0005], [0009], [0016]-[0018], FIG. 1, Abstract. Because Yamane’s receiver *judges a quality* of a *communication* channel over which the signal was transmitted, a POSITA would have recognized that the receiver implements a *communication quality judging device*. EX1004, [0002], [0003], [0007], [0009]; EX1003, ¶67.

Element [1a]

As an initial matter, Yamane's receiver counts the number of errors in a received bit sequence, and a POSITA would have appreciated that the receiver would need to first judge symbols in a received signal to resolve values of bits in the bit sequence as a prerequisite to counting errors. *Id.* Nonetheless, Yamane does not explicitly address how the value of bits in the received bit sequences are resolved from the received signal. *Supra*, §V.A.1; EX1003, ¶67.

In the combination, Mizuki describes a radio paging signal coding control device (FIG. 3) that generates a ***sequence of multilevel symbols*** using frequency shift keying (FSK) modulation. EX1005, 1:52-2:16, 6:37-50, FIGS. 2A-2B, FIG. 8; *supra*, §§V.A.2, V.A.4; EX1003, ¶67. For example, Mizuki discloses that the device can use a "4-valued FSK modulation mode" to cause two-bit symbols to occupy four different levels each corresponding to a respective frequency shift, meaning that Mizuki's control device generates ***multilevel symbols***. *Id.*



EX1005, FIG. 2B.

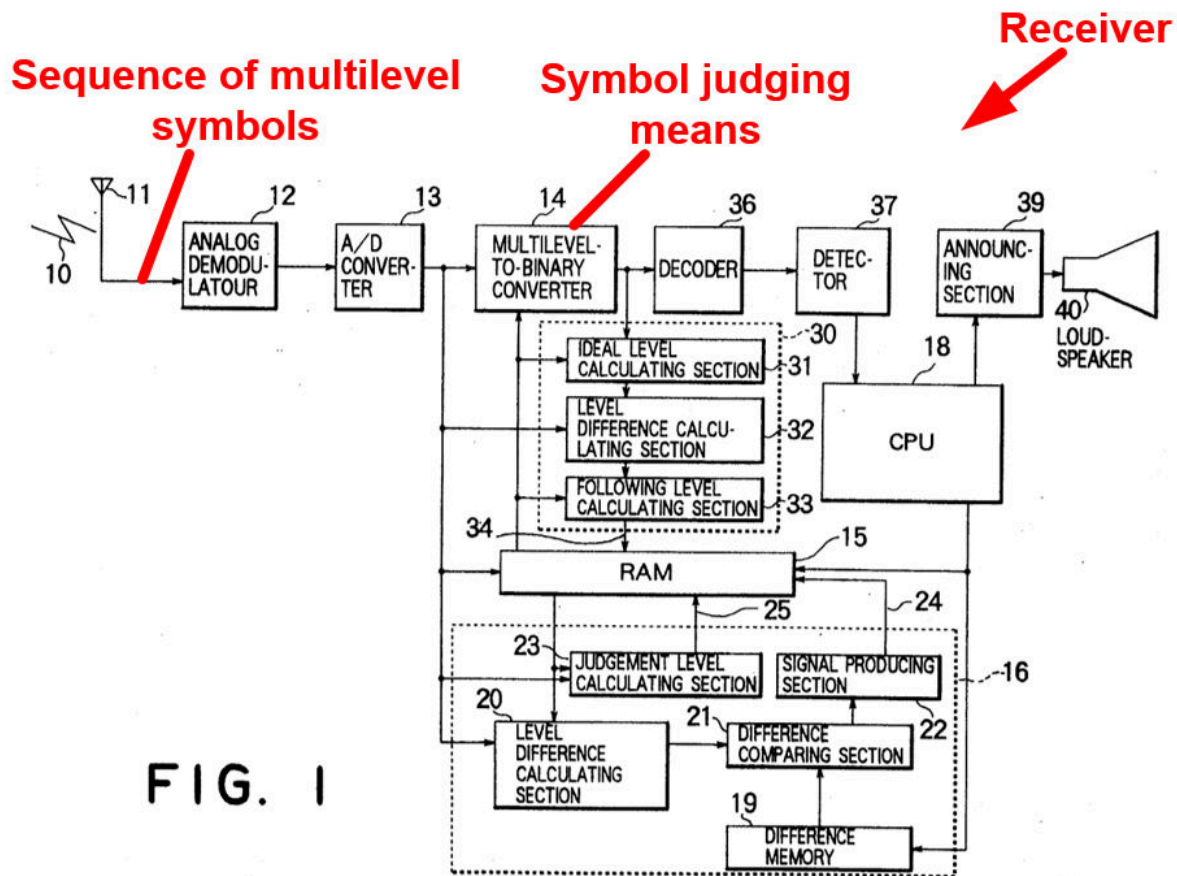
The four frequency shifts of Mizuki $+\Delta F$, $+\left(\frac{1}{3}\right)\Delta F$, $-\left(\frac{1}{3}\right)\Delta F$, and $-\Delta F$ correspond to the symbols “10,” “11,” “01,” and “00,” respectively, which is strikingly similar to the 4-valued FSK system of the ’891 Patent’s preferred embodiment. EX1005, 1:23-2:9; EX1003, ¶67. For example, the ’891 Patent explains that “the baseband signal generating unit T4 converts a symbol “11” contained in the interleaved frame...into a...symbol value of (-3), converts a symbol “10” into...a symbol value of (-1), converts a symbol “00” into a...symbol value of (+1), and converts a symbol “01” into a...a symbol value of (+3),” meaning that the separation between frequency shifts and symbol values in Mizuki

is the same as the separation between frequency shifts and symbol values in the '891 Patent. EX1001, 6:52-59. 7:52-8:8, FIG. 5. In the combination, based on Mizuki, Yamane's system would generate a signal representative of a *sequence* of multilevel symbols just as the '891 Patent's transmitter generates a baseband signal using four-value FSK. EX1005, 1:22-2:28, 6:36-7:14; *supra*, §V.A.4; *cf.* EX1001, 7:32-40.

Mizuki further describes a "known high speed radio paging scheme" that involves a transmitter and a receiver. EX1005, 1:10-47, 2:18-28, 5:11-30, FIG. 5; EX1003, ¶67. For example, Mizuki explains that "[t]he *receiver* can *receive*, *demodulate and decode the subsequent bit sequences* according to a combination of transmission rate and modulation scheme indicated by that frame information." EX1005, 1:34-37. Because Mizuki's is created with each two-bit symbol assigned one of four different values, a POSITA would have understood that the receiver would *judge* each *symbol* in a transmitted baseband signal based on a value associated with that symbol. EX1005, 1:10-47, 2:18-28, 5:11-30, FIG. 5; EX1003, ¶67.

Matsumoto describes additional details of a symbol judging means, which a POSITA also would have found obvious to apply in combination with Yamane and Mizuki. EX1006, 1:8-2:22, 2:41-3:39, FIG. 1; EX1003, ¶67; *supra*, §§V.A.3-4. For example, Matsumoto's radio paging receiver includes an antenna 11 that receives a

multilevel modulated signal 10 and an analog demodulator 12 that “demodulates the multilevel modulated signal 10 into a time sequence of multilevel symbols having analog symbol levels.” EX1006, 2:41-54, FIG. 1; EX1003, ¶67. A POSITA would have understood that the demodulated time sequence of multilevel symbols comprises a ***baseband signal*** as claimed. *Id.* Matsumoto further discloses an analog-to-digital converter 14 that converts the demodulated analog signal into digital values corresponding to each symbol, thereby providing a digital version of the ***baseband signal***. *Id.* The receiver also includes a multilevel-to-binary converter 14 that “serves in cooperating with a RAM (random access memory) 15 as a signal converting section which converts the time sequence of multilevel symbols into a binary (or digital) signal of binary (or digital) values by judging the symbol levels on the basis of judgment levels.” EX1006, 3:16-25, 4:33-36, 4:41-64, FIG. 1.



EX1006, FIG. 1 (annotated).

In the combination, Matsumoto's multilevel-to-binary converter 14 provides a *symbol judging means* that obtains a *baseband signal* that includes a *sequence of multilevel symbols* and *judges* the *symbols* represented by the baseband signal. EX1006, 2:41-4:64, FIGS. 1-3; EX1003, ¶67. Matsumoto explains that the multilevel-to-binary converter 14 judges symbols of a multilevel modulated signal 10 created using FSK that includes four different levels, much like the 4-valued FSK modulation of Mizuki and the '891 Patent. EX1006, 2:55-4:36, FIGS. 1-2.

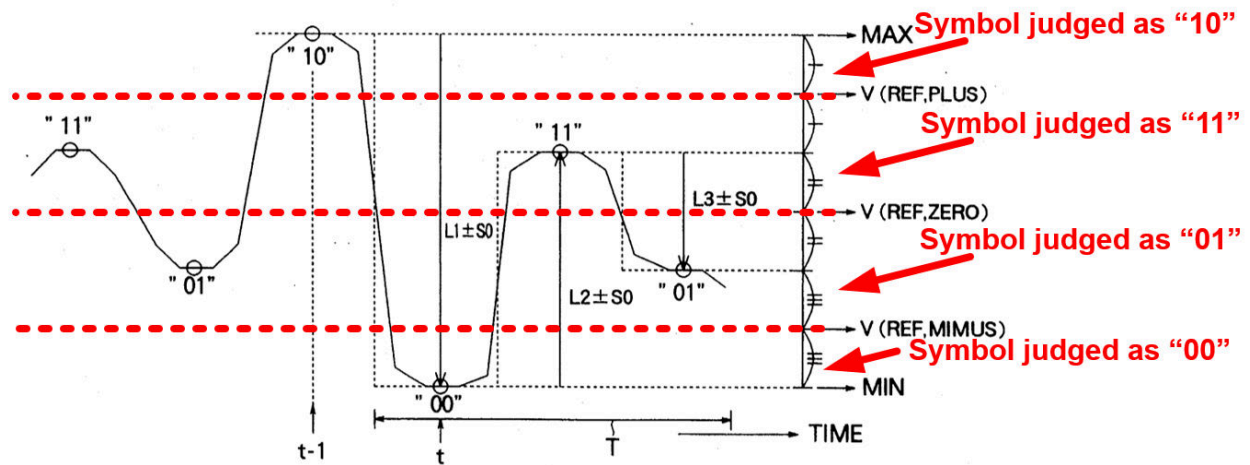


FIG. 2

EX1006, FIG. 1 (annotated).

The Yamane-Mizuki-Matsumoto combination also renders obvious the same techniques for performing the symbol judging function recited in Element [1a] as those disclosed in the '891 Patent, or an equivalent. EX1003, ¶67. As described above, Matsumoto discloses a processor and electronics including a multilevel-to-binary converter 14 configured to obtain from a demodulator a baseband signal representative of a sequence of multilevel symbols, and further configured to judge the symbol by comparing the symbol level to a set of thresholds. EX1006, 2:55-3:6, FIG. 2. For example, Matsumoto explains that the multilevel-to-binary converter 14 judges values greater than the highest judgement level V(ref, plus) as a first symbol value and judges values less than the lowest judgement level V(ref, minus) as a second symbol value, just as symbol judgment unit R3 of the '891 Patent judges values greater than the highest threshold (Th+) as and judges values

less than the lowest threshold ($Th+$) as different symbol values. EX1006, 2:55-3:3, FIG. 2 *cf.* EX1001, 9:50-10:4.

Furthermore, Matsumoto explains that multilevel-to-binary converter 14 judges values less than the highest judgement level $V(\text{ref}, \text{plus})$ and greater than a midway judgement value $V(\text{ref}, \text{zero})$ as a third symbol value just as the '891 Patent explains that symbol judgment unit R3 judges values “less than” the highest threshold ($Th+$) and “not less than” a midway threshold ($Th0$) as a third symbol value. EX1006, 2:55-3:3, FIG. 2 *cf.* EX1001, 9:50-10:4. Matsumoto also explains that multilevel-to-binary converter 14 judges values less than the midway judgement level $V(\text{ref}, \text{zero})$ and greater than the minimum judgment level $V(\text{ref}, \text{minus})$ as a fourth symbol value, just as the '891 Patent explains that symbol judgment unit R3 judges values “less than” the midway threshold ($Th0$) and “not less than” the minimum threshold ($Th-$) as a fourth symbol value. *Id.*

A POSITA also would have appreciated that judging a symbol by comparing a measurement with one or more thresholds was a common and conventional technique by the relatively late Critical Date of the '891 Patent as corroborated by multiple references. EX1008 (describing a system where a reference voltage V_{REF} is compared with one or more thresholds to determine if a symbol is “10,” “11,” “01,” or “00”), EX1009 (describing a system where three reference values are used to differentiate between 10,” “11,” “01,” and “00”); EX1003, ¶67. Additionally,

while the specification and thus claim 1 does not limit symbol judging to always require measuring the instantaneous value at a Nyquist point of the baseband signal, a POSITA would have understood Matsumoto's symbol judging technique as applied in the combination to render obvious or provide an equivalent to such a technique. EX1003, ¶67. Indeed, the '891 Patent explains that measuring at the Nyquist point is done specifically to obtain a value representative of the symbol at each symbol portion of the baseband signal—and this is precisely what Matsumoto does by demodulating the multilevel modulated signal 10 and judging the symbol levels at identified points in the signal representative of the level for each symbol. EX1001, 7:41-51; EX1006, 3:16-4:36. For example, Matsumoto discloses that “the symbol levels of the time sequence of multilevel symbols are equal to a current level at a current time instant (t) and a previous level at a previous time instant (t-1) preceding the current time instant (t), meaning that Matsumoto's system measures instantaneous values at each time interval. EX1006, 3:40-50. This is strikingly similar to the process of the '891 Patent, where Nyquist points occur at time intervals at which point instantaneous values are measured. EX1001, 7:41-51.

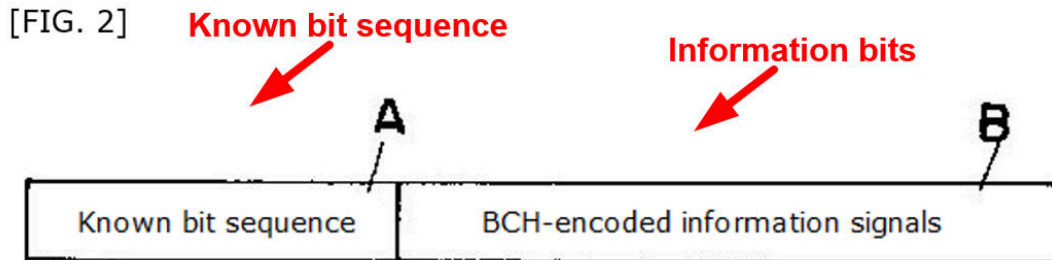
Measuring an instantaneous value of the baseband signal at a Nyquist point for each symbol was also well known before the Critical Date—and noticeably, this fact is expressly admitted in the background of the '891 Patent itself. EX1001, 1:49-60 (describing background approach to judging quality using “a receiving

device [that] measures an instantaneous value at a Nyquist point”). EX1003, ¶67; *supra*, §V.A.4. To the extent claim 1 requires that the baseband signal be measured at the Nyquist point (which it does not), it would have been obvious to a POSITA to do so for at least the reasons admitted in the background of the ’891 Patent, including to obtain a value representative of the symbol level at a point where the baseband signals converges on an ideal value for the symbol. EX1001, 1:49-60. A POSITA also would have desired to employ Nyquist principles because they were well known and better ensured stable sampling, transmission, and reproduction of transmitted signals. EX1003, ¶67; *see also* EX1019, 1701-03 (discussing benefits).

Element [1b]

Yamane discloses a receiver that judges a quality of a communication channel over which a signal including a sequence of bits has been transmitted. EX1004, [0002], [0005]-[0013], [0020]; EX1003, ¶67; *supra*, Element [1pre]; *supra*, §V.A.4. For example, Yamane expressly discloses that “the characteristics of a communication channel can be detected from the number of error bits in [a] received known bit sequence.” EX1004, [0009]. This is because every block of data that is sent over a ***transmission channel*** in Yamane’s system includes a “known bit sequence A” and “BCH-encoded information signals B,” and the receiver judges the quality of the communication channel based on the number of

errors in the known bit sequence. EX1004, [0010], *see also id.*, [0002]-[0009], [0017]-[0020], FIG. 2.



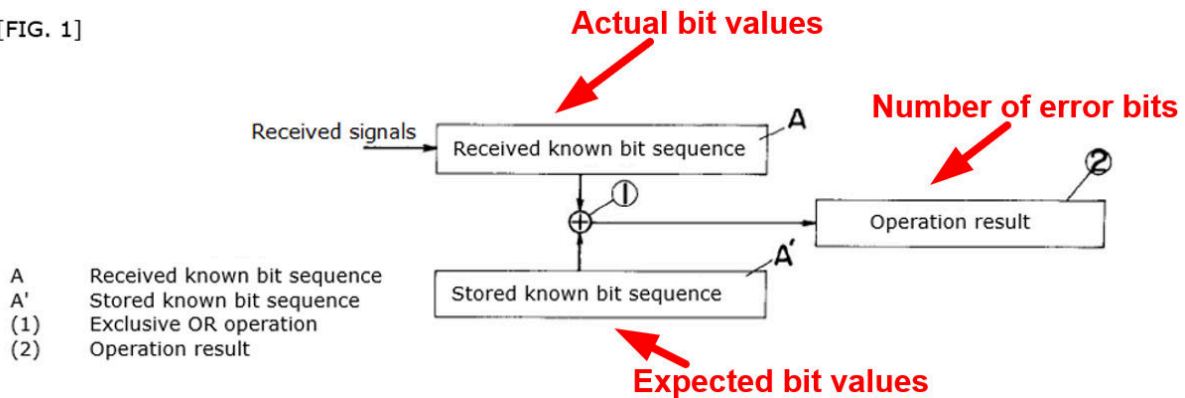
EX1004, FIG. 2 (annotated).



EX1004, FIG. 3B.

Specifically, Yamane explains that the receiver compares the known bit sequence A received in each transmitted data block with a “stored known bit sequence A” at the receiver that indicates the expected values of each bit in the known bit sequence A. EX1004, [0011], *see also id.*, [0007], [0009], FIGS. 1-2; EX1003, ¶67. Based on the comparison between bit values judged from the received signal and expected bit values as indicated by the stored known bit sequence A', the receiver counts a number of “error bits” in the known bit sequence A of a received data block. EX1004, [0011], [0012], [0016]-[0018], FIGS. 1-2.

[FIG. 1]



EX1004, FIG. 1 (annotated).

Yamane explains that “the characteristics of a communication channel are deemed to be good when the value of this count result is small, and conversely, bad when the value is large.” EX1004, [0013]. For example, Yamane discloses that “communication channel characteristics are considered very good” when there are zero error bits and “characteristics of a communication channel are very poor” when there are three or more error bits in the received known bit sequence A. EX1004, [0017], [0018], FIG. 1. Therefore, Yamane discloses a *communication quality judging means* that judges *communication quality* of a *transmission channel* based on the comparison between the received known bit sequence A and the stored known bit sequence A'. EX1004, Abstract, [0002]-[0013], [0016]-[0018], FIGS. 1-2; EX1003, ¶67.

In the combination, and based on Mizuki’s teachings, the signal is transmitted to the receiver by FSK-modulated two-bit multilevel symbols that each

represent a data bit from the information signal B and a redundant bit having a predetermined value (e.g., “0”) from the known bit sequence A. *Supra*, §§V.A.2, V.A.4; EX1005, 6:2-7:28, FIGS. 7-8. The transmitted symbols are then judged at the receiver based on Matsumoto’s teachings to resolve values of the transmitted bits in the known bit sequence A and information signal B. EX1006, 2:41-4:8, FIGS. 1-2; *supra*, §V.A.3; EX1003, ¶67. In the combination, Yamane’s comparison of the received known bit sequence A and the stored known bit sequence A' to determine a number of errors in the received known bit sequence A is therefore based on content of the symbol judged by the symbol judging means. The evidence here also confirms that it was well known how to transmit a baseband signal over a transmission channel before the Critical Date. *Supra*, [1a]; EX1010, 1-2 (describing a system for transmitting a baseband signal including speech data over a radio communication link); EX1011, 21 (describing a system for transmitting a baseband signal including a transmitter and a receiver).

The Yamane-Mizuki-Matsumoto combination also renders obvious the same techniques for performing the communication quality judging function recited in Element [1b] as those disclosed in the '891 Patent, or an equivalent. EX1003, ¶67. Indeed, Yamane’s technique for counting a number of error bits in a received known bit sequence A having predetermined values is substantially the same technique as the error counting process performed by the communication quality

judgment unit R5 in the '891 Patent's preferred embodiment. EX1004, [0007], [0009], [0011], [0012], [0016]-[0018], FIG. 1; *cf.* EX1001, 10:45-11:45. For example, Yamane specifically judges the quality of the communication channel by evaluating the number of errors x detected in the known bit sequence A with respect to a predetermined lower limit n (e.g., 0, 1, or 2) and a predetermined upper limit m (e.g., 3) in order to determine an error control method to apply to the received data:⁵

[Table 1]

Number of error bits in a known bit sequence	Error control method
0	Error detection
1	Error correction
2	Error detection
3 or more	Information signal rejection

EX1004, Table 1

See also EX1004, [0016]-[0018]; *cf.* EX1001, 10:63-11:6, 11:46-48; *see also id.*, 6:46-50; 10:63-11:6. At minimum, a POSITA would have appreciated that Yamane's approach to judging communication quality is equivalent to the

⁵ A POSITA also would have realized that different thresholds for the number of error bits could be applied to select particular error control methods. The selection of appropriate thresholds would have been an obvious design choice left to the discretion of a POSITA. EX1003, ¶67.

techniques disclosed in the '891 Patent. EX1003, ¶67. For example, Yamane and the '891 Patent both recognized that the number of errors detected in a set of redundant bits having known/predetermined values is indicative of channel quality and both counted such errors for substantially the same purpose in substantially the same way (e.g., to judge communication quality and determine whether/how to change data in the received frame). EX1001, 11:46-48; EX1004, [0016]-[0018]; EX1003, ¶67. A POSITA also would have understood and found it obvious to implement the functions described above in the Yamane-Mizuki-Matsumoto combination using a processor or special-purpose circuitry, especially since these functions were conventionally implemented on a processor or special-purpose circuitry to carry out the disclosed operations efficiently and reliably (e.g., comparing digital data sequences and counting error bits). EX1004, [0006] (“efficient reception processing”), [0011], FIG. 1 (logic circuit); EX1005, FIG. 5 (depicting “processing unit[s]”); EX1006, FIGS. 1, 4-5 (depicting CPU 18 and special circuitry); EX1003, ¶67.

Element [1c]

Yamane describes how the receiver can apply an optimized “error control” method selected based on the number of error bits detected in the known bit sequence A for each data block. EX1004, [0014]-[0020]; *supra*, Elements [1pre] and [1b]; EX1003, ¶67. For example, the receiver uses an “error detection” control

method when zero error bits are detected, an “error correction” control method when one error bit is detected, the “error detection” control method when two error bits are detected, and an “information signal rejection” control method when three or more error bits are detected. EX1004, [0016]-[0018]; EX1003, ¶67.

[Table 1]

Number of error bits in a known bit sequence	Error control method
0	Error detection
1	Error correction
2	Error detection
3 or more	Information signal rejection

EX1004, Table 1

With the “information signal rejection” control method, “the received information signals B are not decoded and are rejected because they are considered unreliable due to the number of errors in the received information signals B.”

EX1004, [0018], *see also id.*, [0016]. In rejecting the information signals B, the receiver makes a ***predetermined change*** to the data transmitted over the transmission channel much like the ’891 Patent makes a predetermined change by destroying or muting voices represented by received vocoder output data. EX1004, [0016]-[0020]; *cf.* EX1001, 3:19-22, 11:26-34, 12:1-10, 16:13-19; EX1003, ¶67.

Furthermore, Yamane’s requirement for detecting three or more errors in the received known bit sequence A represents a ***predetermined condition*** for performing information signal rejection. EX1004, [0016]-[0020]. When this

predetermined condition is satisfied—i.e., when three or more error bits are detected from the received known bit sequence—the receiver makes the *predetermined change* by rejecting information signals B. EX1004, [0018]. Stated differently, Yamane’s data changing means makes a *predetermined change* to a received data block (*data to be transmitted*⁶) by rejecting the received information signals B represented by symbols used in the judgment if the communication quality is judged not to satisfy a *predetermined condition* of having less than three errors in the received known bit sequence A. EX1003, ¶67.

⁶ *Supra*, §IV.A.1. While the claims do not require further transmission of the received data, it nonetheless would have been obvious for a POSITA to implement Yamane’s receiver to further prepare the received data to be transmitted to another device since relaying, forwarding, or otherwise transmitting received data was well known before the Critical Date, and a POSITA would have recognized that doing so would allow Yamane’s receiver to convey received data to additional devices that could also make beneficial use of the data. EX1017 (describing an “all digital” radio receiver that produces a digital output), EX1018, FIG. 2 (depicting radio receivers that send digital outputs to other devices), EX1007, FIG. 2 (depicting receiver that transmits received coded voice data to speech decoder 17)); *supra*, §V.A.4; EX1003, ¶67.

The Yamane-Mizuki-Matsumoto combination also renders obvious the same techniques for performing the data changing function recited in Element [1c] as those disclosed in the '891 Patent, or an equivalent. EX1003, ¶67. As discussed above, the corresponding structure for the recited “data changing means” encompasses special-purpose electronics or a processor configured to perform the recited function by replacing, attenuating, or destroying data to be transmitted if the communication quality is judged not to satisfy a predetermined condition, and equivalents thereof. *Supra*, §IV.B.3. Yamane’s information signal rejection serves to destroy the data to be transmitted in the received information signals B just like the received data to be transmitted is destroyed in the '891 Patent. EX1001, 3:19-22, 11:26-34, 12:1-10, 16:13-19, FIG. 8. When Yamane’s data changing means is implemented with the radio receiver system of Mizuki and Matsumoto, the process of rejecting information signals B would involve substantially destroying information signals B so that the error-prone data is not part of the final output signal, just like the example in the '891 Patent. EX1004, [0016]-[0020]; EX1005, 1:22-2:28, 6:36-7:14; EX1006, 2:41-3:39; *supra*, §V.A.4; EX1003, ¶67.

Patent Owner’s infringement allegations in district court suggest that Patent Owner will argue that Element [1c] further encompasses changing data by performing conventional error correction techniques. EX1015, 8-9. Consistent with Patent Owner’s infringement allegations, the Yamane-Mizuki-Matsumoto

combination also renders obvious a data changing means that changes the received data to be transmitted by performing error correction when a predetermined condition is not satisfied (e.g., when the number of error bits in the known bit sequence is not 0 or more than 1), as taught in Yamane. EX1004, [0014]-[0020], Table 1; EX1003, ¶67.

A POSITA also would have understood and found it obvious to implement the functions described above in the Yamane-Mizuki-Matsumoto combination using a processor or special-purpose circuitry, especially as these functions were conventionally implemented on a processor or special-purpose circuitry to carry out the disclosed operations efficiently and reliably (e.g., evaluating conditions to reject a digital information signal or perform error correction). EX1004, [0006] (“efficient reception processing”), [0011], FIG. 1 (logic circuit); EX1005, FIG. 5 (depicting “processing unit[s]”); EX1006, FIGS. 1, 4-5 (depicting CPU 18 and special circuitry); EX1003, ¶67.

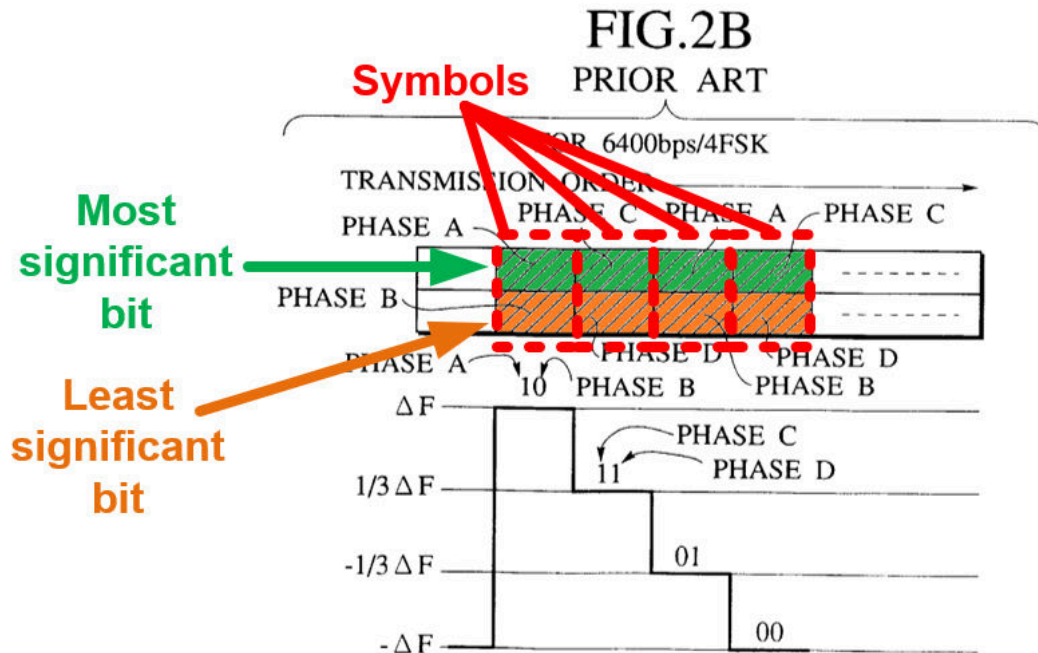
Element [1d]

As discussed above in connection with Elements [1pre] and [1b], Yamane discloses that a signal encoding a ***bit string*** including a known bit sequence A and BCH-encoded information signals B is ***transmitted*** over a transmission channel and obtained by a receiver. EX1004, [0002]-[0007], [0010], FIG. 2; *supra*, [1pre], [1b]; EX1003, ¶67. The known bit sequence A includes bits having ***predetermined***

values that are known to the receiver. EX1004, [0010]-[0012], [0016]-[0020]. For example, the receiver can access a “stored known bit sequence A” that indicates expected values of the known bit sequence A included in each data block. EX1004, [0011]. The receiver can compare the known bit sequence A from the received signal with the stored known bit sequence A' to determine whether any error bits are present in the known bit sequence A. *Id.* The BCH-encoded information signals B represent a ***protected portion*** of the ***bit string*** at least because they are protected by error control methods configured to address errors in the BCH-encoded information signals B. EX1004, [0016]-[0020]. Yamane’s error control methods include error detection, error correction, and information rejection, where the receiver selects an optimal method based on the number of error bits detected in the respective known bit sequence A. *Id.*

To the extent that Yamane does not expressly disclose that its bit string constitutes data to be transmitted represented by a ***sequence of symbols***, or that at least a portion of a symbol in the sequence contains a bit from the ***protected portion*** and a ***redundant bit*** having a ***predetermined value***, these features are provided in the combination and would have been obvious based on Mizuki. EX1005, 1:49-2:27; 6:36-7:14, FIG. 2B, FIG. 8; *supra*, §V.A.2; EX1003, ¶67. For example, Mizuki discloses that a receiver can “receive, demodulate, and decode” data from multiple logical channels (phases) that are encoded using a 4-valued

FSK modulation mode. EX1005, 1:22-37. In the 4-valued FSK modulation mode, bits from two logical channels are paired to form two-bit multilevel symbols, each symbol including a most significant bit that is the first of the two bits and a least significant bit that is the second of the two bits. EX1005, 1:22-2:28, FIG. 2B.



EX1005, FIG. 2B (annotated).

As described for Element [1a] above, Mizuki discloses that the 4-valued FSK modulation mode involves four different frequency shifts each corresponding to a bit value (i.e., $+\Delta F$ corresponding to "10," $+\left(\frac{1}{3}\right)\Delta F$ corresponding to "11," $-\left(\frac{1}{3}\right)\Delta F$ corresponding to "01," and $-\Delta F$ corresponding to "00"). EX1005, 1:63-2:9. FIG. 2B; EX1003, ¶67. In some modes of operation, Mizuki discloses that the most significant bit of a symbol can be an information bit and the least significant

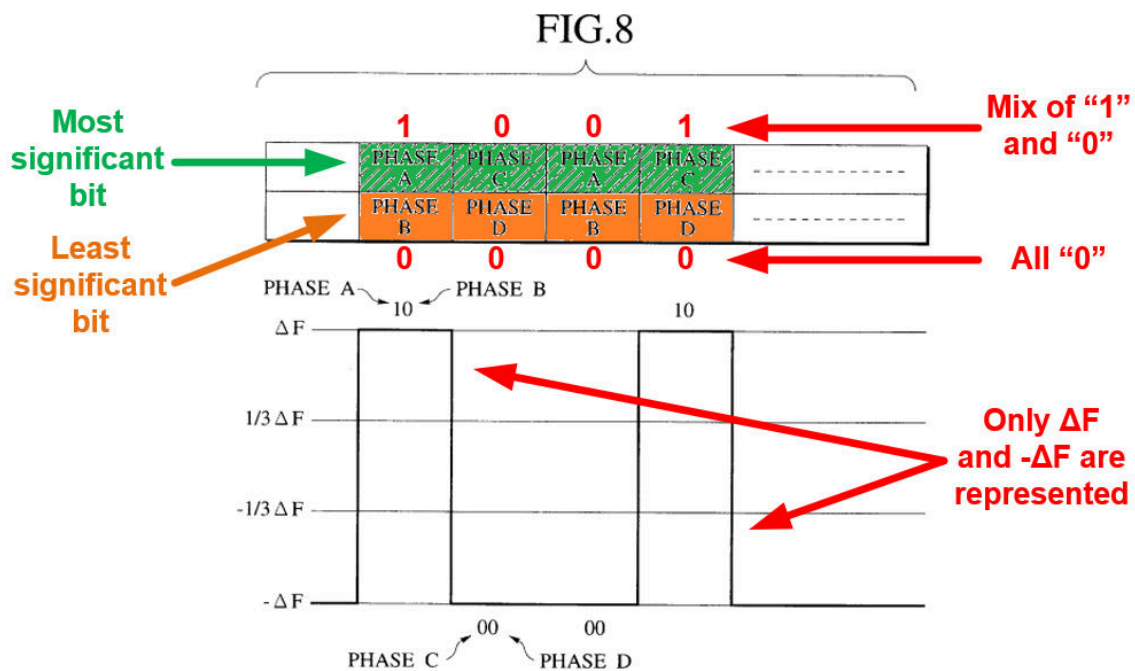
bit of the symbol can be a redundant bit having a predetermined value such as “0”.

EX1005, 6:36-50, FIG. 8. In this example, the only possible frequency shifts are

$+\Delta F$ and $-\Delta F$ because these correspond to the two frequency shifts where the

least significant bit is zero (i.e., “10” and “00”). EX1005, 1:22-2:28, 6:36-50, FIG.

2B, FIG. 8.



EX1005, FIG. 8 (annotated).

As shown above, the most significant bit of every *symbol* in Mizuki includes

an information bit belonging to a *protected portion* that can be either “0” or “1,”

and a least significant bit that is *redundant* and automatically set to a

predetermined value “0.” EX1005, 1:22-2:28, 6:36-50, FIG. 8; EX1003, ¶67.

Mizuki explains that one reason for setting every one of the least significant bits to

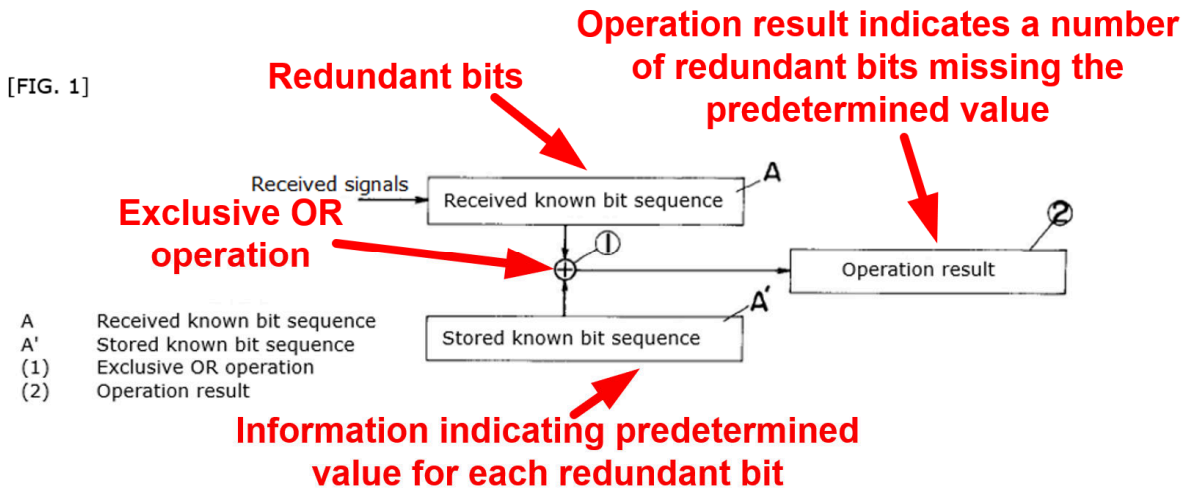
“0” is that when “paging signal traffic is less than or equal to 50% of the transmission capacity,” it is beneficial for differing symbols to be “separated by the maximum signal-to-signal distance,” which in the case of Mizuki’s 4-valued FSK modulation mode is the distance between $+\Delta F$ and $-\Delta F$. EX1005, 16:36-50, FIG. 8. Setting every least significant bit to “0” ensures that the only two possible frequency shifts are $+\Delta F$ and $-\Delta F$, because the intermediate frequency shifts $+\left(\frac{1}{3}\right)\Delta F$ and $-\left(\frac{1}{3}\right)\Delta F$ are each associated with a least significant bit having the value of “1.” EX1005, 1:22-2:28, 6:36-50, FIG. 2B, FIG. 8.

The maximally separated frequency shifts between symbols with different binary values in the most significant information bit makes the transmitted signal more resilient against thermal noise and reduces the change of symbol judgement error at the receiver. *Id.* It would have been obvious to apply Mizuki’s teachings to Yamane such that data bits from Yamane’s BCH-encoded information signals B would be further protected by pairing them with redundant bits having a predetermined value from known bit sequence A to form multi-level symbols that map to only two of the four available states as taught in Mizuki (i.e., the states corresponding to maximal frequency separation). *Supra*, §V.A.4; EX1003, ¶67. Because each symbol has a **redundant** least significant bit set to a **predetermined value**, this ensures that the most significant bit is **protected** by decreasing a

likelihood that the symbol will be corrupted during transmission or misjudged at the receiver. EX1005, 1:22-2:28, 6:36-7:14, FIG. 2B, FIG. 8; EX1004, [0002]-[0007], [0010]-[0020], FIGS. 1-2; *supra*, §V.A.4.

Element [1e]

Yamane explains that the receiver accesses a stored known bit sequence A' that indicates a ***predetermined value*** for every bit of the known bit sequence A included in each ***bit string***. EX1004, [0011], Abstract, FIG. 1; *supra*, [1pre], [1b], [1c]. Every ***bit string*** that is detected by Yamane's receiver includes a bit sequence that is "known" in that every bit value in that sequence is expected to have the ***predetermined value*** indicated by the stored known bit sequence A'. EX1004, [0007]-[0012], FIG. 1. Based on Mizuki, a POSITA also would have found it obvious to set the predetermined value to be the same for every bit in the known bit sequence A that is paired with an information bit from information signals B to form a symbol in the transmitted symbol sequence. *Supra*, §V.A.5; EX1003, ¶67. Mismatches between the known bit sequence A and the stored known bit sequence A' identified by Yamane's ***communication quality judging means*** are referred to as "error bits." EX1004, [0007]-[0013], [0016]-[0018].



EX1004, FIG. 1 (annotated).

Yamane therefore discloses a *communication quality judging means* for identifying a *number of redundant bits* in the known bit sequence A that are *missing a predetermined value* indicated by the stored known bit sequence A' by performing an exclusive OR operation EX1004, [0011], [0016]-[0018], Abstract, FIG. 1; EX1003, ¶67. Based on the *identified result* of this operation which indicates a number of error bits *missing the predetermined value*, Yamane explains that the *communication quality judging means* judges a *communication quality* of the *transmission channel*. EX1004, [0013] (“the characteristics of a communication channel are deemed to be good when the value of this count result is small, and conversely, bad when the value is large”), [0016]-[0020]. For example, Yamane explains that when “the number of error bits in the known bit sequence A is zero,” this means that “the communication channel characteristics are considered very good” and when the number of error bits in the known bit

sequence A is 3 or more,” this means that “the characteristics of a communication channel are very poor.” EX1001, [0017], [0018], Table 1. Therefore, the Yamane-Mizuki-Matsumoto combination renders obvious [1e]. EX1005, 1:49-2:27; 6:36-7:14; *supra*, Element [1b] and §V.A.4.

Claim [3]

Yamane teaches that the receiver rejects the BCH-encoded information signals B when three or more error bits are detected and the *predetermined condition* is therefore *not satisfied*. EX1004, [0016], [0018]; *supra*, Element [1b]; EX1003, ¶67. In the radio receiver of the Yamane-Mizuki-Matsumoto combination, this rejection of the bit string involves *substantially destroying* the BCH-encoded information signals B because “the received information signal B are not decoded and are ... considered unreliable,” analogous to muting voices represented by rejected vocoder output data in the ’891 Patent. EX1004, [0016], [0018]; *cf.* EX1001, 3:28-33 (“substantially destroying the data to be transmitted”), 11:26-34 (“substantially destroy the content of the vocoder output data...such that it represents a silent state”); EX1003, ¶67; *supra*, §V.A.4. In the combination, based on Mizuki’s teachings, the rejected BCH-encoded information signals B is comprised of a bit sequence represented by a *sequence of multilevel symbols* that further represent the known bit sequence A and that are *used to judge* that the *communication quality* does not satisfy the *predetermined condition*. *Id.*

Elements [8pre]-[8e]

Supra, Elements [1pre]-[1e]; EX1004, Cl. 1 (“communication control method”); [0001], [0007]; EX1003, ¶67.

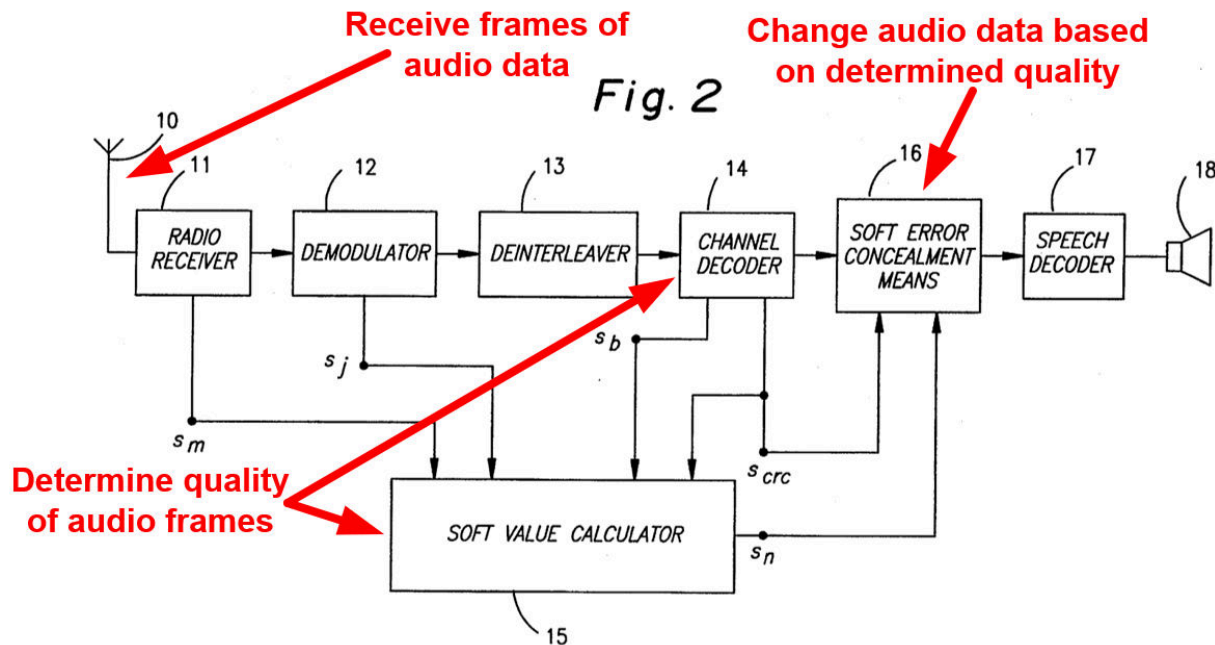
Elements [9pre]-[9e]

Supra, Elements [1pre]-[1e]; EX1005, 5:11-30 and FIG. 5 (describing “processing unit[s]” that would execute a computer program); EX1006, FIG. 1 (describing CPU 18 and RAM 15 for executing a computer program); EX1003, ¶67.

B. GROUND 1B: Obviousness Based on Yamane-Mizuki-Matsumoto-Lagerqvist (Claims 1, 3-9)

1. Lagerqvist

Lagerqvist discloses a receiver in a digital voice coding system that receives coded voice signals and decodes them to produce an audio output. EX1007, 1:12-48, 3:64-4:59, FIG. 2; EX1003, ¶68. Like the ’891 Patent, coded voice data in Lagerqvist’s system is broken into frames for transmission, each frame encoding 20 ms of audio and carrying coded data bits of varying importance. EX1007, 1:21-36, 2:61-3:3, 3:21-62. Lagerqvist explains that a channel decoder 14 of the receiver processes each received frame to determine a quality associated with the frame, for example classifying the frame as being of “good” quality or “bad” quality. EX1007, 4:30-50, 4:60-67.



EX1007, FIG. 2 (annotated).

Lagerqvist explains that soft error concealment means 16 includes a “state machine” that changes audio frames judged to be “bad” by the receiver. EX1007, 4:51-59, FIG. 2; EX1003, ¶69. At each state of the state machine, one or more actions are taken with respect to the received bad audio frame. EX1007, 7:38-8:13, FIG. 4. These actions result in audio frames being attenuated gradually through consecutive bad frames until “no speech signal is heard.” *Id.*

2. The Yamane-Mizuki-Matsumoto-Lagerqvist Combination

Yamane describes a data changing means for making a predetermined change to data if the communication quality does not satisfy a predetermined condition, the predetermined change representing a complete rejection of a

received data block for example. EX1004, [0016], [0018]; EX1003, ¶70; *supra*, §V.A.1. While Yamane describes several error control methods that can be applied based on the measure of communication quality indicated by the number of errors detected in the known bit sequence, a POSITA would have appreciated that other methods of error control were commonly known for different applications. EX1003, ¶70. Lagerqvist describes additional error control methods that likewise involve changing data, but in the context of a voice decoder system. *Supra*, §V.B.1. To the extent that Yamane does not expressly describe a predetermined change where data is replaced with previous data, substantially destroying data following replaced data, or attenuating the data, Lagerqvist demonstrates that these features were not new or innovative before the Critical Date of the '891 Patent. EX1007, 3:64-4:67, 7:38-8:10, FIG. 2, FIG. 4. Multiple reasons would have prompted a POSITA to implement the Yamane-Mizuki-Matsumoto combination in accordance with Lagerqvist's data changing techniques. EX1003, ¶70.

First, a POSITA would have understood that Lagerqvist's teachings would have beneficially expanded the capabilities of the Yamane-Mizuki-Matsumoto combination by allowing it to perform error concealment not only in a generic communication system but also specifically in a voice decoding system. EX1003, ¶71. A POSITA would have been drawn to implement voice error concealment in

the combination because “the speech quality will be improved.” EX1007, 2:48-29; *see also id.*, 1:12-2:57; EX1003, ¶71.

Second, a POSITA would have understood that implementing the receiver of the Yamane-Mizuki-Matsumoto combination to perform voice error concealment like that taught in Lagerqvist by gradually attenuating poor quality audio data would result in a receiver that smoothly conceals low-quality audio instead of abruptly removing poor quality audio. EX1003, ¶72. When bad audio frames are abruptly removed, this leaves gaps of silence in the audio data that can sound jarring to the listener, especially when several gaps occur in succession. EX1003, ¶72.

Third, because Lagerqvist’s frames of audio data are separated into multiple different classes of data, with more important bits receiving additional error protection and less important bits receiving less error protection, a POSITA would have been motivated to implement the receiver of the Yamane-Mizuki-Matsumoto combination according to Lagerqvist’s teachings to provide additional error protection to bits that are most important to decoding the voice signal in a transmitted frame. EX1007, 3:20-63, FIG. 1; EX1003, ¶73. For example, just as the receiver of the ’891 Patent pairs redundant bits with “most important voice data” to provide extra protection while “unprotected voice data” bits are paired together without redundant bits, a POSITA would have been motivated to

implement Mizuki's teachings for pairing information bits with redundant bits with Lagerqvist's teachings for separating data into categories by importance (e.g., selectively pairing most sensitive information bits with redundant bits for additional error resilience while not pairing less sensitive information with redundant bits to increase transmission efficiency). EX1003, ¶73.

Fourth, a POSITA would have understood that Lagerqvist's technique for demodulating a baseband modulated signal, deinterleaving the demodulated signal, and judging communication quality based on the deinterleaved and demodulated signal is well suited to produce a system that uses Yamane's techniques for judging communication quality and makes changes when protected bits are paired in symbols with redundant bits. EX1003, ¶74.

Fifth, a POSITA would have found it obvious to condition use of Lagerqvist's proposed error concealment and data changing operations at least in part on Yamane's measure of communication quality as indicated by the number of error bits detected in the known bit sequence of a received frame. EX1003, ¶75.

Both Yamane and Lagerqvist recognized that error control methods based solely on hard decision criteria such as parity bits or bad frame indicators (BFI) were deficient insofar as they did not fully account for the probability that degraded channel quality may produce errors across different parameters. EX1004, [0001]-[0009]; EX1007, 2:11-3:3, 5:1-5. The application of Lagerqvist's techniques in

combination with Yamane would have been obvious to further the stated objectives of both references and ensure that error concealment is performed according to a “method that is most suitable for the characteristics of the communication channel.” EX1001, 1; EX1003, ¶75.

Sixth, a POSITA would have found it obvious to combine the teachings of Yamane-Mizuki-Matsumoto with Lagerqvist because the combination merely involves the application of a known technique to a conventional system to achieve predictable results. *KSR*, 550 U.S. at 417; *Intel*, 61 F.4th at 1380-81. A POSITA would have reasonably expected success making the combination, especially as it merely involves known techniques that could be implemented on conventional software/hardware that was widely available before the Critical Date of the ’891 Patent. *KSR* at 401; EX1003, ¶77.

3. Application to Challenged Claims

Element [1pre]

Supra, Ground 1A (§V.A.5) at Element [1pre]. EX1003, ¶77. In the combination, Lagerqvist further discloses a radio receiver that evaluates voice data frames to determine a ***communication quality*** of a channel over which the frames were transmitted. EX1007, 4:30-50, 4:60-67; EX1003, ¶77; *supra*, §V.B.2.

Element [1a]

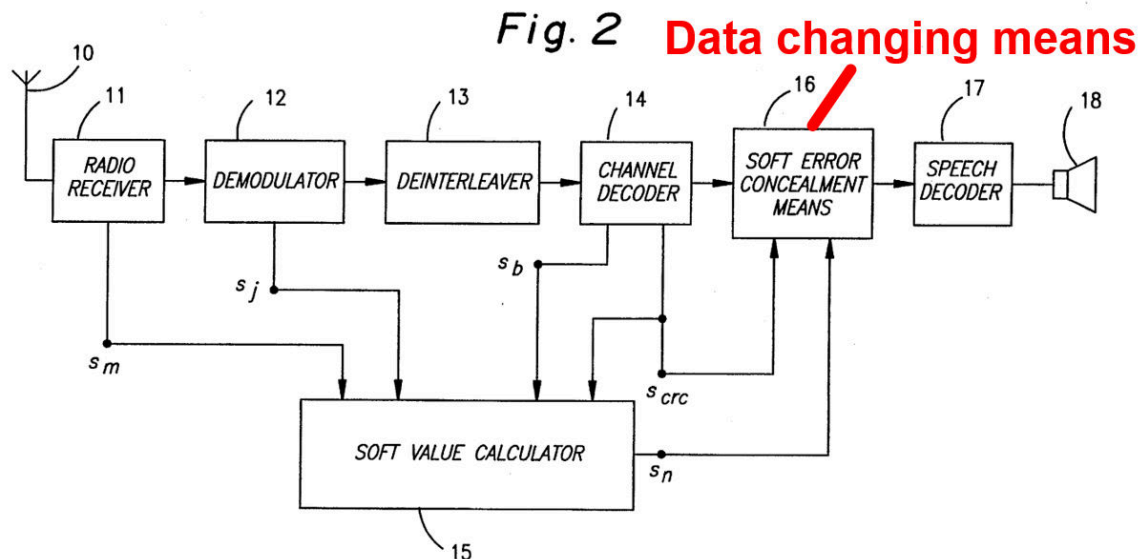
Supra, Ground 1A (§V.A.5) at Element [1a]. EX1003, ¶77. Furthermore, Lagerqvist expressly discloses that the receiver obtains a “baseband modulated signal” over a “radio channel” and demodulates this baseband signal for further processing by the receiver. EX1007, 4:8-26, FIG. 2; EX1003, ¶77; *supra*, §V.B.2.

Element [1b]

Supra, Ground 1A (§V.A.5) at Element [1b]. EX1003, ¶77. While the Yamane-Mizuki-Matsumoto combination renders obvious a ***communication quality judging means*** as claimed for the reasons discussed above in Ground 1A, Lagerqvist reinforces the obvious of this limitation through its disclosure of a receiver that evaluates a quality of voice data frames in a demodulated and deinterleaved baseband signal that is obtained over the transmission channel. EX1007, 4:30-7:36, FIG. 2. For example, Lagerqvist explains that “channel decoder 14...provides a measurement as to how bad, or erroneous, a full speech frame is, so-called bad frame indicator BFI.” EX1007, 4:60-67. Lagerqvist also explains that “[a] so-called neural net or some other soft value calculator 15 may” obtain “a better and more accurate estimation of the quality of the received speech.” EX1007, 4:60-67, FIG. 2; EX1003, ¶77; *supra*, §V.B.2.

Element [1c]

Supra, Ground 1A (§V.A.5) at Element [1c]. EX1003, ¶77. While the Yamane-Mizuki-Matsumoto combination renders obvious a ***data changing means*** as claimed for the reasons discussed above in Ground 1A, Lagerqvist reinforces the obviousness of this limitation through its disclosure of a “soft error concealment means 16” that makes predetermined changes to audio data frames that are judged to have “bad” quality. EX1007, 4:51-59, 7:38-8:10, FIG. 2; EX1003, ¶77.



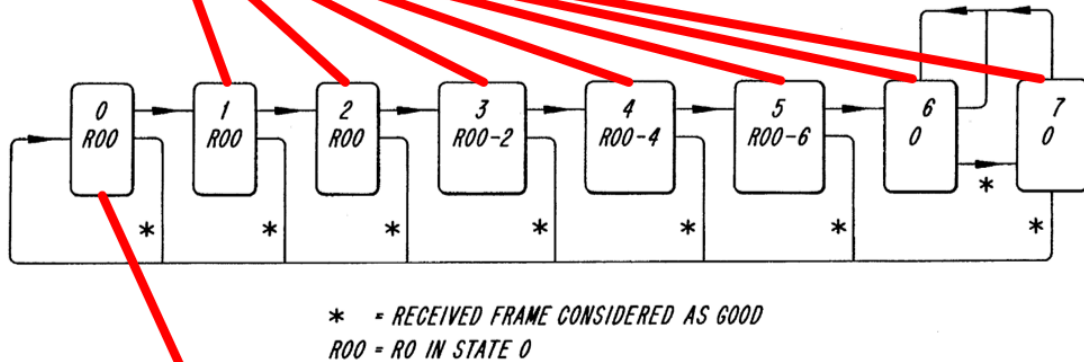
EX1007, FIG. 2 (annotated).

For example, Lagerqvist explains that “[o]ne way to implement [a] bad frame masking technique is to combine it with a state machine with eight states” so that “[w]hen the received information is considered as bad...the state machine moves to the next state.” EX1007, 7:38-55, FIG. 8. Lagerqvist explains that the state machine begins in “state 0,” a state that is applied any time that a frame is

judged to be “good.” EX1007, 7:44-58; EX1003, ¶77. For example, when a good frame is received after one or more “bad” frames, “the state machine returns to state 0,” but if another bad frame is received, the state machine “advances to the next state.” EX1007, 7:44-58, FIG. 8. Aside from state 0 which corresponds to a “good” frame, each of the states in Lagerqvist’s state machine result in the error concealment means 16 performing a *predetermined change* to conceal a bad frame. EX1007, 7:56-8:10, FIG. 8. For example, in state 1 the receiver replaces a received bad frame with “the previous, good frame’s parameters,” in state 3 the receiver makes this same replacement and also decrements the previous good frame’s parameters “which results in a 4 dB attenuation of the frame energy,” and in stage 6 the receiver completely attenuates the parameters so that “no speech signal is heard.” EX1007, 7:56-8:10, FIG. 8; EX1003, ¶77.

States 1-7 each result in a predetermined change that conceals a received “bad” frame

Fig. 4



In state 0, the current received frame is “good” and no predetermined change is made

EX1007, FIG. 4 (annotated).

As another example, Lagerqvist’s error concealment means 16 can make a *predetermined change* even to a good frame by “interpolat[ing]” the “incoming frame ... with the last accepted frame” if the quality measure if the quality measure falls within a defined range but is not sufficiently poor to indicate a bad frame. EX1007, 7:51-55; EX1003, ¶77.

In the combination, and for the reasons discussed above, it would have been obvious to a POSITA to further modify the Yamane-Mizuki-Lagerqvist system based on Lagerqvist such that the *data changing means* in the combination would be configured to implement any of the predetermined changes for concealing errors in the data as described in Lagerqvist. EX1003, ¶77; *supra*, §V.B.2. Based on a straightforward application of Lagerqvist’s teachings, the quality measure used to

indicate a bad frame or to otherwise trigger a predetermined change to the data would be based at least in part on the communication quality indicated by a number of errors in the known bit sequence as taught in Yamane relative to a predetermined lower limit n (e.g., 1 or 2) and a predetermined upper limit m (e.g., 3), consistent with Lagerqvist's desire to more comprehensively account for quality factors in determining when to apply error concealment to a bad frame. EX1004, [0016]-[0020]; EX1007, 2:11-3:3, 5:1-5; EX1003, ¶77; *supra*, §V.B.2; *infra*, Claims [4]-[7].

Elements [1d]-[1e]

Supra, Ground 1A (§V.A.5) at Elements [1d]-[1e]. EX1003, ¶77.

Claim [3]

In addition to the teachings of Yamane-Mizuki-Matsumoto that address claim 3 as described above in Ground 1A, Lagerqvist also teaches that the predetermined change can include a process of substantially destroying the data by attenuating the voice data to a zero level when a predetermined condition is not satisfied: "In state 6 R0 is set to the value 0 which means that no speech signal is heard. In state 7 R0 is still set to 0." EX1007, 8:8-10; *see also id.*, 7:44-8:13, FIG. 4; *supra*, Ground 1B, Element 1[c]; Ground 1A, Element [1c] and Claim [3]; EX1003, ¶77; *supra*, §V.B.2. This is substantially the same action disclosed in the '891 Patent for destroying data. EX1001, 11:30-34 ("destroy the vocoder output

data ... such that it represents a silent state”).

Claim [4]

Lagerqvist explains that the *predetermined change* can include *replacing* a current voice data frame judged to be “bad” with the most recently received voice data frame judged to be “good.” EX1007, 4:30-50, 4:60-67, 7:38-8:10; *supra*, [1c]; EX1003, ¶77. Lagerqvist’s soft error concealment means 16 includes a state machine that applies the *predetermined change* to a bad voice data frame based on the number of consecutive bad voice data frames preceding this current bad voice data frame. EX1007, 4:60-67, 7:38-8:10, FIG. 4.

Lagerqvist explains that in one embodiment, the state machine includes eight states numbered “state 0” through “state 7.” EX1007, 7:44-8:10, FIG. 4. When a received voice data frame is good, the state machine occupies state 0, which Lagerqvist describes as the “normal state.” EX1007, 7:44-58, 7:64; EX1003, ¶77. No matter in which state the state machine occupies when a good voice data frame is received, “the state machine returns to state 0” in every case. *Id.* This means that receiving a good voice data frame always results in the state machine restarting at state 0 and the good data frame is not altered in any way. *Id.*

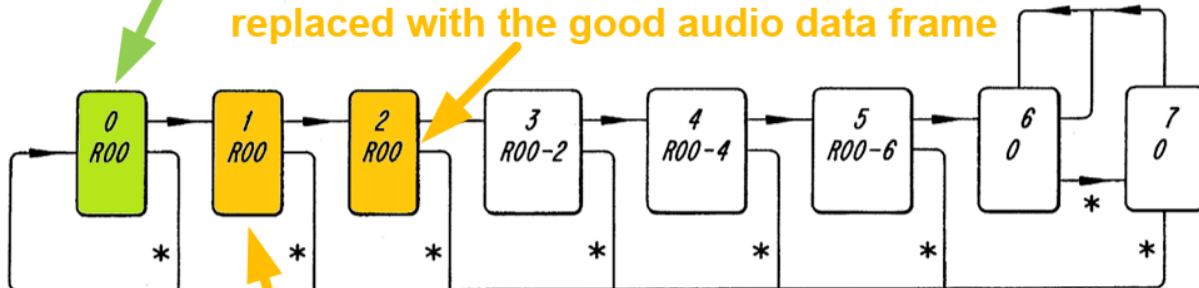
When the receiver determines that a voice data frame is bad, however, the state machine moves to the next state in the sequence of states 0 through 7. EX1007, 7:44-61; EX1003, ¶77. For example, a first bad voice data frame received

consecutively after a good voice data frame advances the state machine to state 1, a second bad voice data frame received consecutively after the first bad voice data frame advances the state machine to state 2, and so on. EX1007, 7:44-8:10, FIG. 8. Several states following state 0 result in **replacing** the data in a bad voice data frame with **previous data** of a good voice data frame received before the bad voice data frame. *Id.* For example, when the state machine occupies state 1, “the received frame parameters” of a first bad voice data frame received consecutively after a good voice data frame “are **replaced** by the previous, good frame’s parameters.” EX1007, 7:64-8:1, FIG. 8. Lagerqvist explains that in state 2, “the same action is taken,” meaning that a second bad voice data frame received consecutively after the first bad voice data frame is **replaced** by the previous data of the good voice data frame. *Id.*

In state 0, no changes are made to the good audio data frame

Fig. 4

In state 2, a second bad audio data frame is replaced with the good audio data frame



* = RECEIVED FRAME CONSIDERED AS GOOD
ROO = RO IN STATE 0

In state 1, a first bad audio data frame is replaced with the good audio data frame

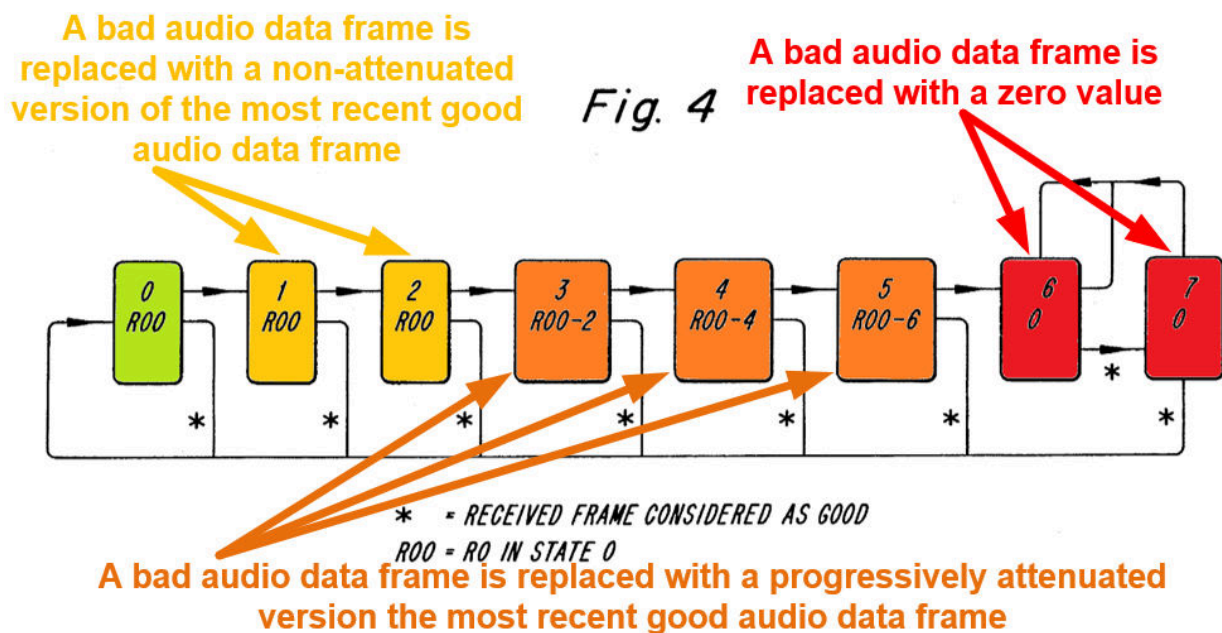
EX1007, FIG. 4 (annotated).

When the Yamane-Mizuki-Matsumoto combination is implemented with Lagerqvist's data changing suggestions, the receiver makes a *predetermined change* that involves *replacing* the *data to be transmitted* used to judge that the *communication quality* does not satisfy a *predetermined condition* with *previous data* that was obtained by the *symbol judging means*. EX1007, 7:38-8:10, FIG. 8; EX1003, ¶77.

Claim [5]

According to Lagerqvist, if additional bad voice data frames are received following state 2 of the state machine, the state machine continues to advance to later stages. EX1007, 7:44-58, FIG. 4; EX1003, ¶77. For example, when a third

bad voice data frame is received consecutively after the second bad voice data frame corresponding to state 2, the state machine advances to state 3. EX1007, 8:2-4, FIG. 4. Lagerqvist explains that “[i]n state 3 the replacement of frame parameters is done again” and “the value of $R0$ is decreased by 2, which results in a 4 dB attenuation of the frame energy.” *Id.* This decrease continues through states 4 and 5 so that bad voice data frames are replaced by the most recent good voice data frame on a continuously diminished basis. EX1007, 8:5-7, FIG. 4.



EX1007, FIG. 4 (annotated).

When the state machine reaches state 6, the receiver has obtained six consecutive voice data frames that the receiver judges to be of bad quality. EX1007, 7:44-58, 8:8-9, FIG. 4; EX1003, ¶77. In state 6, the receiver replaces the currently received bad voice data frame with “the value 0 which means that no

speech signal is heard.” EX1007, 8:8-9, FIG. 4. This same change is made in state 7, where the currently received bad voice data frame “is still set to 0.” EX1007, 8:10. This represents a ***predetermined change*** that includes a process of ***substantially destroying*** the ***data to be transmitted*** that is included in the currently received bad voice data frame, because setting the parameters to zero ensures that no sound is generated in response to the receiver obtaining the bad voice data frame. EX1007, 8:8-9, FIG. 4.

This step of ***substantially destroying*** the ***data to be transmitted*** corresponding to stage 6 happens after stage 1 and stage 2 where a previously received bad data frame is replaced with the most recently received good data frame. EX1007, 7:38-8:10, FIG. 4; EX1003, ¶77. Stage 6 also occurs after stages 3 through 5, where a previously received bad data frame is replaced with a progressively attenuated version of the most recently received good data frame. *Id.* Therefore, Lagerqvist describes a data changing means that ***substantially destroys*** ***data to be transmitted*** of the currently received bad voice data frame that follows ***last replaced data*** of a previously received bad voice data frame that was replaced with a most recently received good data frame. *Id.*

Furthermore, Lagerqvist’s stage 6 step of ***substantially destroying*** the ***data to be transmitted*** occurs when a bad frame is replaced with data from the most recently received good frame more than a ***predetermined number*** of times.

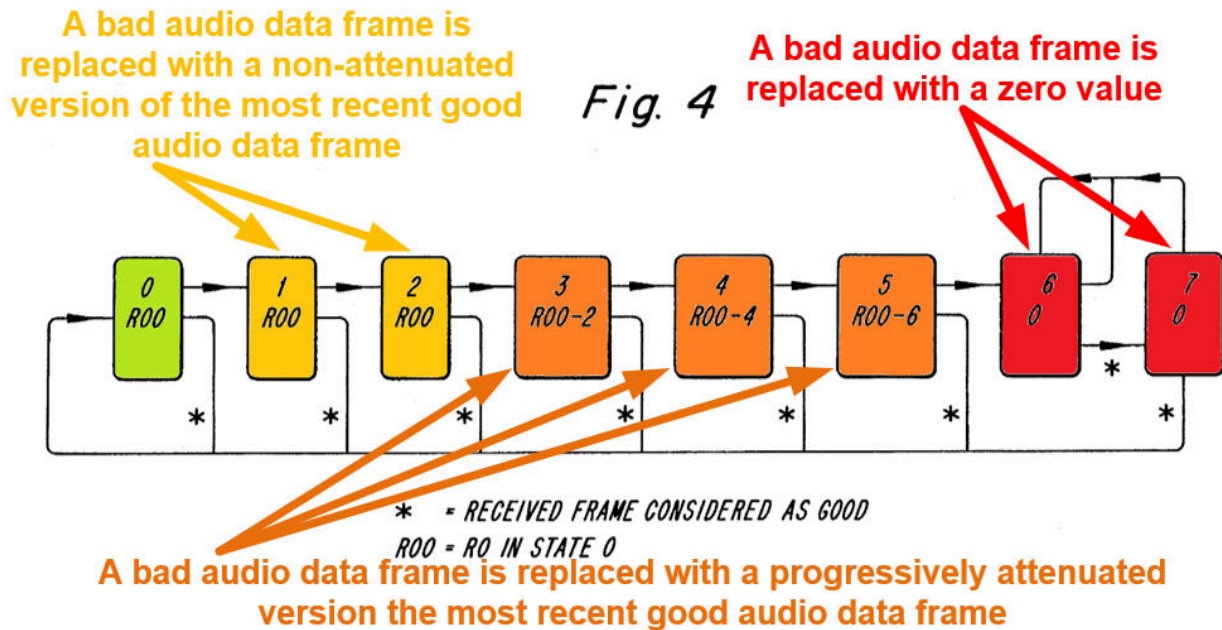
EX1007, 7:38-8:10, FIG. 4; EX1003, ¶77. For example, because Lagerqvist explains that the state advances each time that the receiver obtains a bad data frame and *substantially destroying the data to be transmitted* first occurs at stage 6, this means that *substantially destroying the data to be transmitted* occurs after a bad data frame is replaced five times, a *predetermined number*. *Id.* When the Yamane-Mizuki-Matsumoto combination is implemented with Lagerqvist's data changing teachings, the resulting receiver *substantially destroys the data to be transmitted* corresponding to symbols of the currently received bad data frame that follows *last replaced data* of a previously received bad data frame that is represented by the *symbol* used to judge that the *communication quality*. *Id.*

Claim [6]

Lagerqvist explains that the *data to be transmitted* of the bad data frame subject to a *predetermined change* by the *data changing means* comprises data representative of *strength of a variable*. EX1007, 7:44-8:10, FIG. 4; EX1003, ¶77. Lagerqvist expressly discloses that “[i]n state 1 the received frame parameters (RC and LPC1 LPC10) are replaced by the previous, good frame's parameters” and “[i]n state 3 the replacement of frame parameters is done again “ so that “*the value of R0 is decreased by 2, which results in a 4 dB attenuation of the frame energy.*” EX1007, 7:65-8:4, FIG. 4. Thus, Lagerqvist acknowledges that the parameters of a

voice data frame are *variables* that are representative of the *strength* of the voice data frame. *Id.*

The state machine described by Lagerqvist includes at least three states—i.e., state 3 through state 5—where a bad data frame is replaced with an attenuated version of a most recently received good data frame. EX1007, 7:65-8:7, FIG. 4; EX1003, ¶77. In addition to state 3 where “the value of R0 is decreased by 2,” Lagerqvist also discloses that in state 4 “R0 is decreased again by 2” and in state 5 “[t]he same actions are taken...as in state 4.” *Id.* This means that Lagerqvist discloses that the *predetermined change* includes an *attenuating process* of replacing the current received bad frame with an attenuated version of a most recently received good frame. *Id.* The *attenuating process* of Lagerqvist therefore involves changing the *data to be transmitted* corresponding to the current received bad frame to a *data equivalent* corresponding to the most recently received good frame in which the variable for the data is *attenuated* from the full value of the *data equivalent*. *Id.*



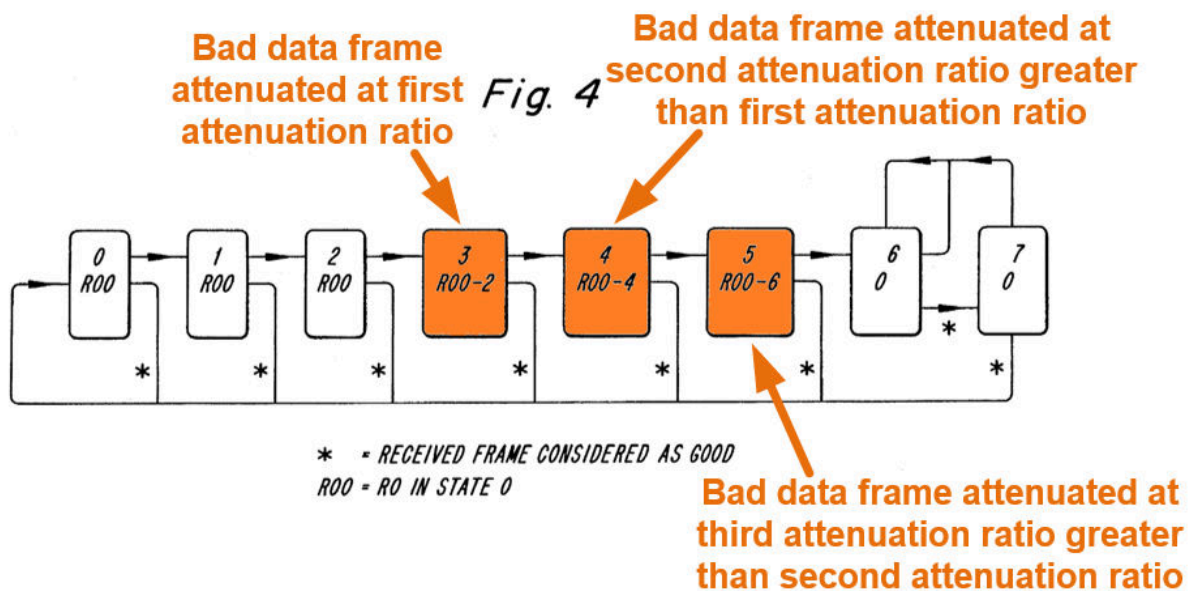
EX1007, FIG. 4 (annotated).

When the Yamane-Mizuki-Matsumoto combination is implemented with Lagerqvist's data changing teachings, the resulting receiver applies a *predetermined change* that includes an *attenuating process* of changing *data to be transmitted* of the received bad data frame represented by the symbol used to judge that the data frame is bad quality to a *data equivalent* of the most recently received good data frame that is *attenuated*. EX1007, 7:65-8:10, FIG. 4; EX1003, ¶77.

Claim [7]

As described for claim [6], *supra*, the state machine of Lagerqvist includes three states (i.e., states 3 through 5) where a current received bad frame is replaced with an attenuated version of the most recently received good frame. EX1007, 7:38-8:10, FIG. 4; EX1003, ¶77. In these three states, the level of attenuation is

increased moving from earlier states to later states. EX1007, 8:2-7, FIG. 4. For example, Lagerqvist explains that in state 3 “the value of R0 is decreased by 2,” in state 4 “R0 is decreased again by 2” and in state 5 “[t]he same actions are taken.” *Id.* FIG. 4 of Lagerqvist depicts state 3 as involving “R00-2,” state 4 as involving “R00-4,” and state 5 as involving “R00-6,” where “R00” represents the parameters of the most recently received good data frame. EX1007, FIG. 4.



EX1007, FIG. 4 (annotated).

Therefore, in state 3 of Lagerqvist’s state machine, **first data** is received in the form of a bad data frame that consecutively follows two previous bad data frames corresponding to states 1 and 2, respectively. EX1007, 7:38-8:7, FIG. 4; EX1003, ¶77. This **first data** is subjected to an **attenuating process** where “the

replacement of frame parameters is done” and “R0 is decreased by 2, which results in a 4 dB **attenuation** of the frame energy.” EX1007, 8:2-4, FIG. 4. An attenuation ratio applied in state 3 is depicted in FIG. 4 of Lagerqvist is “R00-2.” *Id.* After receiving the **first data** representing one bad data frame, the receiver obtains **second data** representing a consecutive bad data frame. EX1007, 7:38-8:7, FIG. 4. Upon receiving the second data, the state machine occupies state 4 and the receiver applies an attenuating process where RO is decreased again by 2 so that the attenuation ratio is “R00-4.” EX1007, 8:2-4, FIG. 4.

Lagerqvist therefore provides that the receiver applies an **attenuating process** to **first data** and **second data**, the **second data** being obtained by the receiver consecutively after the **first data**. EX1007, 7:38-8:7, FIG. 4; EX1003, ¶77. The **attenuating process** applied to the **second data** has an **attenuation ratio** of “R00-4,” which is larger than the attenuation ratio (“R00-4”) in the **attenuating process** applied to the **first data**. *Id.*

Elements [8pre]-[8e]

Supra, Elements [1pre]-[1e]; EX1004, Cl. 1 (“communication control method”); [0001], [0007]; EX1003, ¶77.

Elements [9pre]-[9e]

Supra, Elements [1pre]-[1e]; EX1005, 5:11-30 and FIG. 5 (describing “processing unit[s]” that would execute a computer program); EX1006, FIG. 1

(describing CPU 18 and RAM 15 for executing a computer program); EX1003, ¶77.

C. GROUND 1C: Obviousness Based on Yamane-Mizuki-Matsumoto-Kaplan (Claim 2)

1. Kaplan

Kaplan discloses how a user can “interface[] with the circuitry and microprocessor of [a mobile telephone] device through a keypad, or touchpad, located on the front outer surface of the housing.” EX1016, [0004]. Kaplan also teaches that mobile phones can be “configured, or ‘provisioned’, for various modes of operation” that “determine[] how basic functions of the mobile will operate, such as setting or resetting wireless voice and data exchange protocol parameters, parameters used to enable or disable communication features, and local network services available to the mobile” including “enhance vocoder” features. *Id.*, [0004]; *see also id.*, [0001]-[0014], [0023]; EX1003, ¶78.

2. The Yamane-Mizuki-Matsumoto-Kaplan Combination

Yamane discloses a radio receiver configured to operate in a wireless environment and to judge the quality of a wireless communication channel. EX1004, [0005]-[0011]. Yamane discloses little detail about the hardware of the receiver device or the manner in which the receiver is configured or provisioned, however. A POSITA therefore would have looked to other references such as

Kaplan for specific guidance on how to implement the receiver and ensure it is configured with suitable software and operational parameters. EX1003, ¶79.

Kaplan, for example, teaches that devices can be configured or provisioned by externally obtaining parameters over the air (OTA), from user input, or from other devices “via RF signals, or cable connections.” EX1016, [0004]-[0008]. It would have been obvious to a POSITA to apply Kaplan’s teachings to the receiver device in the Yamane-Mizuki-Matsumoto combination of Ground 1a to achieve known and predictable benefits, including the ability to flexibly configure/provision the device with new or updated software and operational parameters even after the device’s initial production and to expand the capabilities of the device through new software received through an external interface (e.g., a wireless connection, cable connection, keyboard or the like). *Id.*, [0004]-[0010]; *KSR*, 550 U.S. at 417; *Intel*, 61 F.4th at 1380-81; *supra*, §V.A.4. A POSITA would have reasonably expected success implementing the combination as confirmed by Kaplan’s teaching that such interfaces for receiving external configuration parameters were well known before the Critical Date. EX1003, ¶79.

3. Application to Challenged Claims

Claim [2]

As discussed above, Kaplan discloses conventional techniques for externally obtaining software and operational parameters for a mobile phone. *Supra*, §V.C.1-

2; EX1016, [0004]-[0016]. When Kaplan's teachings are applied to the Yamane-Mizuki-Matsumoto combination, it would have been obvious for Yamane's receiver to externally obtain a parameter that defines at least a portion of the predetermined condition for determining when to make a predetermined change to the received data to be transmitted. *Supra*, §V.C.1-2; EX1003, ¶80. For example, a POSITA would have recognized that the parameter would be included in configuration or provisioning information obtained from an external source as taught in Kaplan. EX1016, [0004]-[0016]; *see also id.*, Abstract.

Like the '891 Patent, Kaplan explains that the parameters can be received based on user input to a keyboard and/or connections to external devices such as an external computer or recording media drive. EX1016, [0004] ("user interfaces"; "keypad"), [0005] ("configuration can be ... set after connection" or "upon entering an appropriate access code"), [0006] ("information obtained from the server"), [0008] ("information is exchanged between mobiles or between mobiles and other devices such as computers via RF signals, or cable connections"). A POSITA also would have found it obvious based on Kaplan to externally obtain Yamane's parameters for selecting an error control method or changing the data to be able to optimize the selection based on current operating conditions, frame size, size of the known bit sequence, and the like. EX1003, ¶80. The teachings of

Yamane-Mizuki-Matsumoto-Kaplan thus render obvious the additional “means” element recited in claim 2 and its corresponding structure, or an equivalent. *Id.*

VI. INSTITUTION SHOULD NOT BE DENIED ON DISCRETION

Petitioner believes that discretionary denial is unwarranted, and yet, Petitioner intends to utilize the bifurcated briefing process contemplated by the March 26, 2025, Stewart Memorandum to rebut contentions if offered by Patent Owner to the contrary. See <https://www.uspto.gov/about-us/events/learnaboutnew-interim-processes-relating-institution-aia-proceedings> (April 24, 2025); <https://uspto.cosocloud.com/p9xpz6s4jn75> (Video).

VII. CONCLUSION AND PAYMENT OF FEES

The Challenged Claims are unpatentable. Petitioner authorizes charge of fees to Deposit Account 06-1050.

VIII. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8(a)(1)

A. Real Party-In-Interest Under 37 C.F.R. § 42.8(b)(1)

Apple Inc. is the sole petitioner and the real party-in-interest.

B. Related Matters Under 37 C.F.R. § 42.8(b)(2)

The '891 Patent is the subject of civil actions including: *Advanced Coding Technologies LLC v. Apple Inc.*, 2-24-cv-00687 (EDTX), filed August 20, 2024 and *Advanced Coding Technologies LLC v. Google LLC*, 2-24-cv-00353 (EDTX), filed May 10, 2024. Google LLC filed a petition for *inter partes* review of the

'891 Patent on June 17, 2025 in IPR2025-01161.

C. Lead And Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3)

Petitioner provides the following designation of counsel.

Lead Counsel	Backup counsel
W. Karl Renner, Reg. No. 41,265 Fish & Richardson P.C. 60 South Sixth Street, Suite 3200 Minneapolis, MN 55402 Tel: 202-783-5070 Fax: 877-769-7945 Email: IPR50095-0246IP1@fr.com	Jeremy J. Monaldo, Reg. No. 58,680 Nicholas W. Stephens, Reg. No. 74,320 Cameron A. Ubel, Reg. No. 77,081 Fish & Richardson P.C. 60 South Sixth Street, Suite 3200 Minneapolis, MN 55402 Tel: 202-783-5070 Fax: 877-769-7945 Email: IPR50095-0246IP1@fr.com

D. Service Information

Please address all correspondence and service to the address listed above.

Petitioner consents to electronic service by email at IPR50095-0246IP1@fr.com.

Respectfully submitted,

Dated: June 30, 2025

/Nicholas W. Stephens/
W. Karl Renner, Reg. No. 41,265
Jeremy Monaldo, Reg. No. 58,680
Nicholas Stephens, Reg. No. 74,320
Cameron A. Ubel, Reg. No. 77,081
Fish & Richardson P.C.
60 South Sixth Street, Suite 3200
Minneapolis, MN 55402
T: 202-783-5070
F: 877-769-7945

(Control No. IPR2025-01221)

Attorneys for Petitioner

CERTIFICATION UNDER 37 CFR § 42.24

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for *Inter Partes* Review totals 13,982 words, which is less than the 14,000 allowed under 37 CFR § 42.24.

Dated: June 30, 2025

/Nicholas W. Stephens/
W. Karl Renner, Reg. No. 41,265
Jeremy J. Monaldo, Reg. No. 58,680
Nicholas W. Stephens, Reg. No. 74,320
Cameron A. Ubel, Reg. No. 77,081
Fish & Richardson P.C.
60 South Sixth Street, Suite 3200
Minneapolis, MN 55402
T: 202-783-5070
F: 877-769-7945

(Control No. IPR2025-01221)

Attorneys for Petitioner

CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on June 30, 2025, a complete and entire copy of this Petition for *Inter partes* Review, Power of Attorney, and all supporting exhibits were provided via Federal Express, to the Patent Owner by serving the correspondence address of record as follows:

Robinson Intellectual Property Law Office, P.C.
3975 Fair Ridge Drive
Suite 20 North
Fairfax, VA 22033
(571) 434-6789

/Crena Pacheco/

Crena Pacheco
Fish & Richardson P.C.
60 South Sixth Street
Minneapolis, MN 55402
pacheco@fr.com