IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of: Eberlein et al.
U.S. Patent No.: 6,314,289
Issue Date: November 6, 2001
Serial No.: 09/202,729
Title: Apparatus and Method for Transmitting Information and Apparatus and Method for Receiving Information
***Inter Partes* Review No.: IPR2018-00690**

DECLARATION OF ERNST EBERLEIN

I, Ernst Eberlein, declare as follows:

1. I am a co-inventor of U.S. Patent No. 6,314,289 ("the '289 patent"). The other co-inventors of the '289 patent are Marco Breiling, Jan Stoessel, and Heinz Gerhäuser.

2. I graduated as Engineer from the University in Erlangen and joined Fraunhofer Gesellschaft zur Forderung der Angewandten Forschung eV ("the Fraunhofer Institute") in 1985.

3. From 1987 to 1994, I supported the audio and multimedia department of the Fraunhofer Institute. As a group leader in this department, I was involved in the development of the mp3 audio coding scheme. In 1992, I was a co-recipient of the Joseph von Fraunhofer Award for this work.

4. In 1995, I began working on the physical layer of digital communication systems. In connection with that work, I became heavily involved in the design and implementation of satellite-based digital radio systems for mobile

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reception. In 2002, the results of my work in this area were elected to the Space Technology Hall of Fame.[1]

5. Throughout 1998, my primary project at Fraunhofer, together with my colleagues Sabah Badri, Stephan Buchholz, Stefan Lipp, and Jan Stoessel, was the development of a new satellite-based digital radio system. Others involved in the development of the system during this time included Marco Breiling, Robert Fischer (both employees of the University Erlangen, working on a sub-contract basis for Fraunhofer), Albert Heuberger (head of department and senior advisor), and Heinz Gerhaeuser (head of institute and senior advisor). Others at Fraunhofer were further involved in additional aspects of building and testing this system, including field experiments and/or chipset design.

6. My co-inventors and I collaborated together to conceive a new proposal for a satellite-based digital radio system utilizing diversity combining no later than October 1998. Exhibit 2051 is a true and correct copy of invention disclosure materials related to that proposal, which were prepared in October 1998. I will refer to Exhibit 2051 as "the '289 IDF." I completed drafting the '289 IDF on October 26, 1998, as indicated on the first page. Exhibit 2051 at 1. The '289 IDF formed the basis for international patent application PCT/EP98/07850 that was filed on December 3, 1998 (Exhibit 2052) and which ultimately matured into the '289 patent.

7. As evidenced by Exhibits 2051-2054 and the facts set forth in this declaration, the inventions as claimed in each of claims 1-6, 8-15, 17-23, 25-33 and 35 of the '289 patent were conceived no later than October 26, 1998 and diligently reduced to practice no later than the December 3, 1998 filing date of international application PCT/EP98/07850 (Exhibit 2052), the parent application of U.S. application 09/202,729, which issued on November 6, 2001 as the '289 patent.

8. Other aspects of the '289 patent invention are further disclosed in a document entitled, "Proposal for Puncturing Pattern for 3/8 code," which I prepared on or about November 23, 1998. A true and correct copy of this document is attached as Exhibit 2053. This disclosure describes specific generator polynomials used by the convolutional encoder of the system, as recited in dependent claims 7 and 24 of the '289 patent. These claims were conceived no

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[1] *See* <https://www.spacefoundation.org/space_technology_hal/satellite-radio-technology/>.

later than November 23, 1998 and were likewise diligently reduced to practice no later than December 3, 1998, as reflected in this declaration.

9. Following the conception of these inventions, my colleagues and I diligently and continuously worked to reduce them to practice (including both actual and constructive reduction to practice). For example, work toward creating an embodiment of the inventions was undertaken with the objective of preparing a final "specification (waveform and chipset) by January 15th, 1999." *See, e.g.*, Exhibit 2051 at 5. Our ongoing efforts in this regard proceeded according to the schedule set forth in Exhibit 2051, including (1) evaluating through October 30, 1998 whether data "indicates that post-Viterbi and post-Reed-Solomon decoding are not sufficient or an additional gain of 2-4 dB will improve the service availability significant[ly]"; (2) additional analysis performed from October "until the end of November [1998]" including "[a]nalysis of 'Code rate 1/3 approach' by system simulation," "[d]evelopment of draft chipset spec.," use of "external memory … for the delay," and a "Viterbi decoder for code rate 1/3"; (3) use of "preliminary results" at the "beginning of December [1998]" to "adapt the draft specification." *Id*. at 5-6. As part of this work, we "developed and tested" simulations of an embodiment of the inventive system. *See, e.g., id*. at 5 (describing our "simulation setup"). I also personally prepared the Simulation Plan dated November 9, 1998 that is included here as Exhibit 2054. This document references the October 26, 1998 memorandum (Exhibit 2051) in which conception of the inventions is described. Exhibit 2054 at 4. It also sets forth a schedule of activity for "Theoretical Analysis" (*id*. at 5-6) and "Validation using broadcast channel data only" (*id*. at 7-8), which describe work performed related to analyzing, simulating, and testing aspects of the invention with deliverable dates on November 17, 20, 24 and December 4, 1998. Note that I was continuously in Fraunhofer Institute's employ throughout this time period, and this was my sole, full-time project at least during the last quarter (October through December) of 1998. We also continued to develop and refine aspects of an embodiment of this invention, as shown, for example, by the November 23, 1998 disclosure entitled, "Proposal for Puncturing Pattern for 3/8 code," which is included as Exhibit 2053, in which further work to reduce to practice an embodiment of the invention is disclosed, including puncturing patterns and generator polynomials for the convolutional encoder. The technical specification and the simulation work were the basis for the chipset implementation.

10. Moreover, in accordance with the Fraunhofer Institute's standard invention disclosure procedures, my co-inventors and I disclosed our idea to Fraunhofer Institute management so that it could be submitted to patent counsel for

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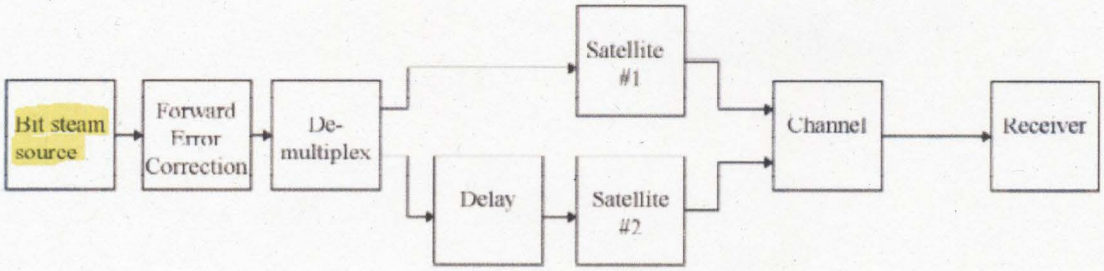
the purpose of drafting a patent application. Beginning in October 1998, we, the inventors, and other Fraunhofer Institute personnel (totaling about 20 individuals) worked continuously to reduce the invention to practice, including work on developing the air-interface specification, validation by simulation, chipset specification, and field experiments to test the system, as well as working with patent counsel in preparing, reviewing and revising the specification, figures and claims of international application PCT/EP98/07850 (Exhibit 2052) up to its December 3, 1998 filing date. This international application is the parent application of U.S. application 09/202,729 which issued on November 6, 2001 as the '289 patent.

11. The following is a detailed description elaborating some of the evidence that demonstrates the conception and reduction to practice of the claims of the '289 patent on an element-by-element basis.

12. The '289 IDF describes a method and an apparatus for transmitting information. For example, it describes how "[t]he output of the convolutional encoder and puncturing unit is demultiplexed," after which "4 bits out of 8 are transmitted over satellite 1" and "[t]he other 4 bits are transmitted over satellite 2." Exhibit 2051 at 2.

13. The '289 IDF describes a bitstream source for providing a bitstream representing information. For example, it shows a "transmission system" comprising a "Bit stream source":



Id. at 1.

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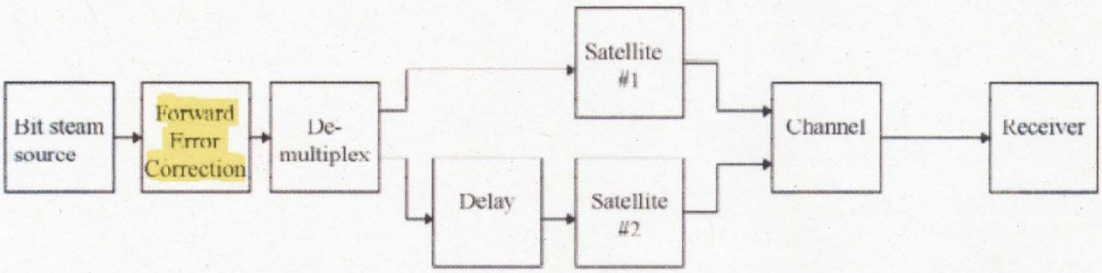
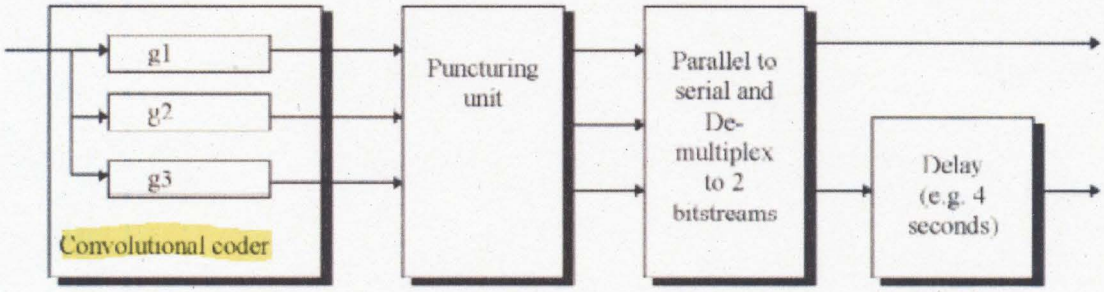
14. The '289 IDF further describes a redundancy adding encoder for generating an encoded bitstream based on the bitstream provided by the bitstream source wherein the encoder is arranged to output, for a first number of input bits, a second number of output bits, the second number of output bits having at least twice as many output bits as the first number of input bits. For example, it shows the disclosed transmission system includes a Forward Error Correction component for encoding the output of the Bit Stream source to add redundancy:



Id. at 1. The '289 IDF further describes an implementation of forward error correction utilizing "a convolutional encoder with code rate 1/3." *Id.* at 2. The convolutional encoder with code rate 1/3 is further illustrated by the '289 IDF, showing a convolutional encoder taking one input bit and yielding three output bits:



Id.

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