UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

COMCAST CABLE COMMUNICATIONS, LLC,
Petitioner,

v.

ENTROPIC COMMUNICATIONS, LLC,
Patent Owner.

Case IPR2024-00435
Patent 11,381,866

EXHIBIT 2009

DECLARATION OF SAMUEL H. RUSS, PH.D.

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I. INTRODUCTION

1. My name is Samuel H. Russ. I have been retained as an expert witness to provide my independent opinion in regard to the matters at issue in *inter partes* review of U.S. Patent No. 11,381,866 ("the '866 patent") in IPR2024-00435. I have been retained by Entropic Communications, LLC ("Entropic"), the Patent Owner in this proceeding. The Petitioner is Comcast Cable Communications, LLC ("Comcast" or "Petitioner").

2. I am being compensated at my standard hourly rate for my time spent working in connection with this case. I am also being reimbursed for expenses that I incur during the course of this work. My compensation is in no way related to the outcome of this litigation. If called as a witness, I would testify as to the statements and opinions contained in this report.

3. My analysis of the materials produced in this matter is ongoing and I will continue to review any new material as it is provided. This declaration represents only those opinions I have formed to date. I reserve the right to amend or supplement my opinions based on additional documents or evidence I am presented, including without limitation any arguments or expert declarations advanced by Petitioner in this case.

4. I am not a legal expert and offer no opinions on the law. However, I have been informed by counsel of the various legal standards that apply, and I have applied those standards in arriving at my conclusions.

II. QUALIFICATIONS

5. I have more than 20 years of experience in the fields of broadband cable networks and communications engineering. As explained below, I have authored a reference textbook on signal processing, authored or co-authored 32 journal articles and conference papers in the areas of video storage, video networking and consumer electronics. I am a named inventor on 51 patent applications, which have led to 29 issued U.S. patents and 9 European patents. My professional career has been dedicated to issues relating to signal integrity, communication systems, and home networking more generally. A detailed record of my professional qualifications is set forth in the attached Exhibit 2010, which is my *curriculum vitae*, including a list of publications, awards, research grants, and professional activities. My *curriculum vitae* also lists the matters in which I have served as an expert.

6. I received a Bachelor of Science in Electrical Engineering with Highest Honors from Georgia Institute of Technology in 1986 and a Ph.D. in Electrical Engineering from Georgia Institute of Technology in 1991. My Ph.D.

dissertation was titled "An Information-Theoretic Approach to Analysis of Computer Architectures and Compression of Instruction Memory Usage."

7. I am currently an Associate Professor in the Department of Electrical and Computer Engineering at the University of South Alabama. I joined the Electrical and Computer Engineering faculty in 2007. I have taught a number of classes including classes in signal integrity, embedded systems, and the design of high-speed digital systems. During that time, I won awards for excellent teaching and have been actively publishing research in signal integrity, home networking, and digital video recording (DVR) technologies.

8. Previously, from 1994 to 1999, I served on the faculty of Mississippi State University as an Assistant Professor in the Department of Electrical & Computer Engineering. I taught circuit board design and two-way interactive video classes, among other topics.

9. I also have significant industry experience. From 2000 to 2007, I was the manager in the Advanced Technologies R&D group for Scientific-Atlanta (later Cisco, now Technicolor). As part of this work, I explored major new technologies including home networking and multi-room video distribution and managed a cable set-top box (STB) design group that designed four STB models for the cable television industry, including the Explorer 4200 (non-DVR) and 8300 (DVR) models. Both models were produced in high volumes and sold several

million units. As the design-group manager, I was responsible for managing the design and prototyping activities of the group and for interfacing with other groups (especially integrated circuit design, procurement, software developers, the factory where prototypes were built, and product managers). I also maintained the hardware and mechanical development schedule.

10. While at Scientific-Atlanta, I became a staff expert in home networking, and conducted demonstrations of wireless video technology. I also managed a group that developed a new coaxial home networking system. This coaxial system won a Technology and Engineering Emmy Award in 2013. Further, I was a staff expert in digital video recorder (DVR) reliability, and led a team that improved the software, hardware, repair, and manufacturing processes.

11. I am the author of *Signal Integrity: Applied Electromagnetics and Professional Practice*, Springer, 1st ed. 2016, 2nd ed. 2022. I have also researched and written about video storage, multimedia broadcasting over networks, embedded systems, consumer electronics, set-top boxes, access of stored video from peer devices in a local network, electronic manufacturing systems, and other topics in video and image processing. I have authored or co-authored 32 journal articles and conference papers in these areas of video storage, video networking and consumer electronics. One of my conference papers on digital video recording

won second place in a "Best Paper" competition at the 2011 International Conference on Consumer Electronics in Las Vegas, Nevada.

12. I am a named inventor on 51 patent applications that were filed while I was at Scientific-Atlanta, many of which focus on cable technology. These applications have led to 29 issued U.S. patents and 9 as European patents, including U.S. Patent No. 7,908,625 ("Networked Multimedia System").

III. BASES OF OPINIONS

13. In the course of conducting my analysis and forming my opinions, I have reviewed materials including those listed below:

i. U.S. Patent No. 11,381,866 (Ex. 1001) ("the '866 patent") and its prosecution history;

ii. The Petition and all cited exhibits therein;

iii. Declaration of David B. Lett (Exhibit 1002) and all exhibits cited therein;

iv. The Institution Decision (Paper 13);

v. All the exhibits cited in my declaration herein.

IV. APPLICABLE LEGAL STANDARDS

A. Level Of Ordinary Skill In The Art

14. My opinions in this declaration are based on the understandings of a person of ordinary skill in the art, which I understand is sometimes referred to as

an "ordinary artisan" or by the acronyms "POSITA" or "PHOSITA," as of the time of the invention, which I understand is here assumed to be the effective filing date (April 17, 2009) provisional application from which the '866 patent issued. I understand that the person of ordinary skill in the art is a hypothetical person who is presumed to have known the relevant art at the time of the invention. By "relevant," I mean relevant to the challenged claims of the '866 patent.

15. I understand that factual indicators of the level of ordinary skill in the art include the various prior art approaches employed, the types of problems encountered in the art, the rapidity with which innovations are made, the sophistication of the technology involved, and the educational background of those actively working in the field. I understand that, in assessing the level of skill of a person of ordinary skill in the art, one should consider the type of problems encountered in the art, the prior solutions to those problems found in the prior art references, the rapidity with which innovations are made, the sophistication of the technology, the level of education of active workers in the field, and my own experience working with those of skill in the art at the time of the invention.

16. In this case, Mr. Lett has asserted in his declaration that a person of ordinary skill in the art as of the time of the '866 patent would have had:

> a degree in electrical engineering or a similar discipline, along with three-to-four years of experience with digital signal processing (DSP) and radio frequency (RF) tuning systems for satellite and/or cable

communications. Additional education may substitute for professional experience, and significant work experience may substitute for formal education.

Ex. 1002 [Lett-Decl.] ¶ 31.

17. For the purposes of this declaration, I have applied Mr. Lett's proposed qualifications of a POSITA.

18. As further discussed below, my opinions as stated in this declaration are valid even if the Board adopts a slightly different level of ordinary skill in the art.

B. My Understanding Of Legal Standards

19. When considering the '866 patent and stating my opinions, I rely on the following legal standards as described to me by the attorneys for Entropic.

20. I understand that a patent claim is unpatentable if the claimed invention was anticipated by a prior art reference or would have been obvious to a person of ordinary skill in the art at the time of the purported invention.

21. I understand that anticipation requires that every limitation of the claim at issue be disclosed, either expressly or under principles of inherency, in a single prior art reference.

22. I understand that inherency may not be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of

circumstances is not sufficient. Instead, it must be proven that the claim limitation not expressly found in the reference necessarily follows from what is found there.

23. I understand that an obviousness analysis involves comparing a claim to the prior art to determine whether the claimed invention would have been obvious to a person of ordinary skill in the art at the time of the invention in view of the prior art and in light of the general knowledge in the art as a whole. I also understand that obviousness is ultimately a legal conclusion based on underlying facts of four general types, all of which must be considered: (1) the scope and content of the prior art; (2) the level of ordinary skill in the art; (3) the differences between the claimed invention and the prior art; and (4) any objective indicia of non-obviousness, including any praise of the invention.

24. I also understand that obviousness may be established under certain circumstances by combining or modifying the teachings of the prior art. Specific teachings, suggestions, or motivations to combine any first prior art reference with a second prior art reference can be explicit or implicit, but must have existed before the date of purported invention. I understand that prior art references themselves may be one source of a specific teaching or suggestion to combine features of the prior art, but that such suggestions or motivations to combine art may come from the knowledge that a person of ordinary skill in the art would have had.

25. I understand that a reference may be relied upon for all that it teaches, including uses beyond its primary purpose, but also including teachings that lead away from the invention. I understand that a reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, although the mere disclosure of alternative designs does not teach away.

26. I further understand that whether there is a reasonable expectation of success in combining references in a particular way is also relevant to the analysis.

27. I understand that it is improper to use hindsight to combine references or elements of references to reconstruct the invention using the claims as a guide. My analysis of the prior art is made from the perspective of a person of ordinary skill in the art at the time of the invention.

28. I understand that in order to be eligible as prior art in obviousness and therefore form a reference in one of the instituted grounds, a reference must be analogous art to the ’866 patent. I also understand that it is Petitioner’s burden to prove that their asserted references are analogous art to the ’866 patent.

29. I am not offering any legal opinions in this declaration nor am I qualified to do so. I only consider such legal standards in framing my opinions and conclusions as well as placing assertions made by Petitioner in the Petition into the proper context. Additionally, from a subject matter perspective, I understand that

the petitioner always has the burden of persuasion regarding a challenge of patentability of an invention under an inter partes review.

V. CLAIMS-AT-ISSUE (CLAIMS 1-82)

30. I understand that Petitioner has challenged the claims as follows:

- Ground A: claims 1, 14, 27, 41, 3–7, 9, 11, 13, 16–20, 22, 24, 26, 29-33, 35-37, 40, 43–47, 49–51, and 54 are not anticipated by Zhang under pre-AIA 35 § 102;
- Ground B: Claims 1, 3–7, 9, 11, 13, 14, 16–20, 22, 24, 26, 27, 29–33, 35–37, 40, 41, 43–47, 49–51, 54 are not obvious over Zhang under pre-AIA § 103(a);
- Ground C: Claims 9–12, 22–25, 27, 29–33, 35–40, 41–40 3–47, 49–54, 55, 57–61, 63–68, 69, 71–75, 77–82 or not obvious over Zhang in view of Reisman under pre-AIA § 103(a);
- Ground D: Claims 2–6, 15–19, 28–32, 42–46 are not obvious over Zhang in view of Jackson under pre-AIA § 103(a);
- Ground E: Claims 28–32, 42–46, 46–60, 70–74 are not obvious over Zhang in view of Reisman and further in view of Jackson under pre-AIA § 103(a);

- Ground F: Claims 1, 3–9, 11, 13, 14, 16–22, 24, 26, 34–36, 48–50 are not obvious over Zhang in view of Pandey under pre-AIA § 103(a);
- Ground G: Claims 9–12, 22–25, 34–36, 48–50, 62–64, 76–78 are not obvious over Zhang in view of Reisman and further in view of Pandey under pre-AIA § 103(a);
- Ground H: Claims 2–6, 15–19 are not obvious over Zhang in view of Pandey and further in view of Jackson under pre-AIA § 103(a);

VI. OPINIONS

A. Overview: Zhang, Unlike The '866 Patent, DOWN CONVERTS AND Extracts All Channels, Both Desired And Undesired.

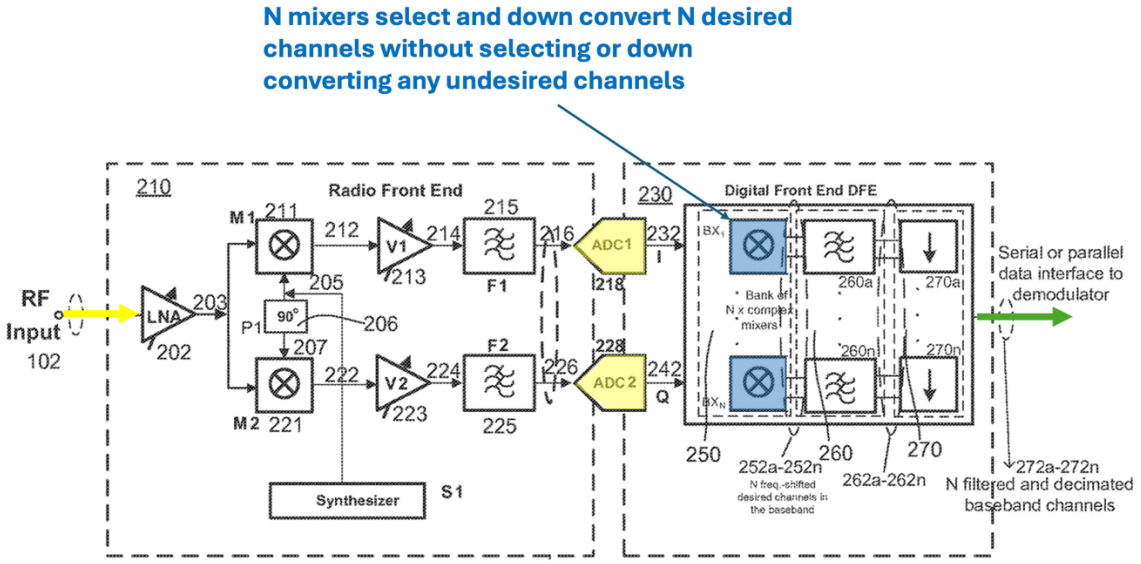
31. Zhang is the cornerstone of each of Petitioner's grounds. Pet., 11-12. Although both Zhang and the '866 patent involve a digitized RF input signal, and, ultimately, output desired RF channels, the method by which they achieve this result is critically different. Specifically, the '866 patent selects and down converts ***only*** the desired channels without selecting or down converting any undesired channels. In contrast, Zhang down converts and extracts ***all*** channels, ***both*** desired and undesired, from the digitized input RF signal, and only later selects the desired channels from the extracted channels.

32. Understanding what a "down conversion" is requires a brief discussion of the underlying technological background. In order to transmit information, the information is first converted into a baseband signal. However, the baseband signal cannot be directly transmitted, including because its frequency is too low for effective transmission. Therefore, the baseband signal is modulated on a signal at a much higher frequency in order to be transmitted. Additionally, by modulating different data streams at different frequencies, multiple data streams can share a common medium, such as a coaxial cable. This higher frequency signal is called a transmission carrier, and it is this modulated transmission carrier that is transmitted out of the antenna. In such instances, the baseband signal is said to be "up converted" to the transmission carrier.

33. At the receiver, when the modulated carrier signal is received, it should be "down converted" from the carrier frequency to the baseband frequency. Sometimes this down conversion is directly to the baseband frequency, and sometimes it is done in multiple stages by first down converting the carrier signal to an "intermediate frequency." Sometimes, the down conversion is performed by a circuit element called a "mixer."

34. The '866 patent outputs desired channels by selecting and down converting only the desired channels from the digitized input RF signal. The Figure 2 embodiment of the '866 patent, annotated below, is illustrative. There,

the analog input RF signal (yellow) is first digitized in the analog to digital converters (yellow). Ex. 1001 ['866] 5:48-51. Then, a bank of N mixers (blue) selects and down converts N desired channels, without selecting or down converting any undesired channels, from the digitized input RF signal. *Id*., 5:51-55, 5:63-6:6. The selected and down converted desired channels are then output to demodulators (green). *Id*., 7:10-14.



'206 Pat. Fig. 2 (modified and annotated)

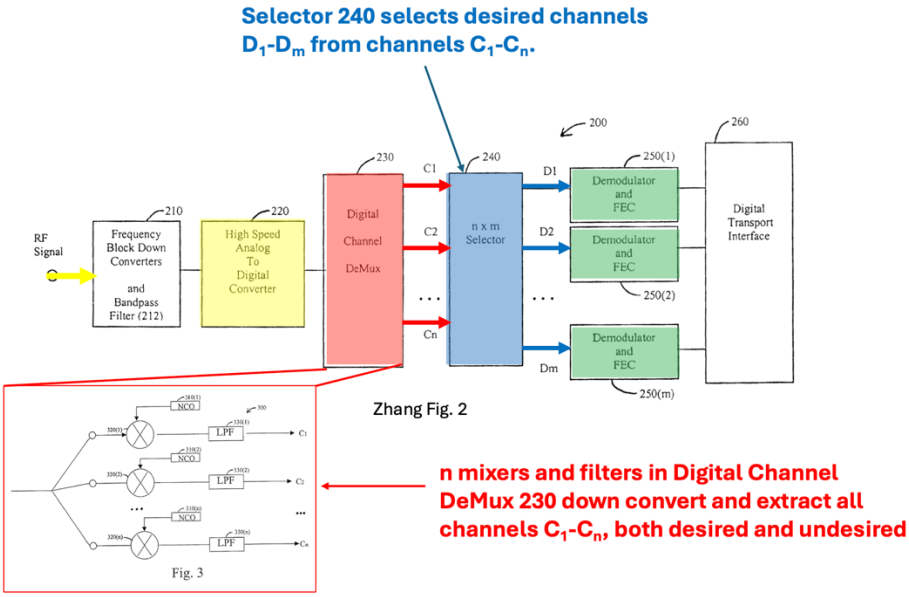
35. In Zhang, creating an output of desired channels is achieved through a different method, which I explain in the context of Zhang's Figures 2 and 3, annotated below. Similar to the '866 patent, Zhang digitizes an input signal (yellow), consisting of "n" desired and undesired channels, in the analog to digital converter 220 (yellow). Ex. 1013 [Zhang] [0027] ("In this specific embodiment, ADC 220 is a high-speed ADC so that an entire signal band with n channels can be

converted"). Note that the letter "n" in Zhang denotes the number of both desired and desired channels, whereas the letter "N" in the '866 patent denotes the number of desired channels.

36. Unlike the '866 patent, however, Zhang's method then down converts and extracts from the digitized RF input signal ***all*** channels C_1-C_n, ***both*** desired ***and*** undesired, in the Digital Channel DeMux 230 (red). *Id*., [0028] ("A digital channel demultiplexer 230 then demultiplexes the multi-channel digital RF signal into separate digital RF channels C_1 to C_n."). The exemplary architecture of Zhang's Digital Channel DeMux 230 is shown in Zhang's Figure 3, which I have included in the annotation below. Note that even though Zhang's Digital Channel DeMux 230 uses complex mixers similar to the '866 patent to extract channels, the complex mixers down convert both desired and undesired channels, unlike the '866 patent.

37. Once both desired and undesired channels C_1-C_n are down converted and extracted from the digitized input signal, the digital channel selector 240 (blue) selects the desired channels and outputs them to demodulators (green). *Id*., [0028] ("an n×m digital selector 240 receives the demultiplexed digital RF channels C_1 to C_n and then selects one or more of the RF channels D_1 to D_m from one or mor of the digital RF channels C_1 to C_n."); [0039] ("In operation, digital selector 500

digitally selects one or more RF channels D_1 to D_m from the digital RF channels C_1 to C_n and then sends them to appropriate demodulators ….").



38. As explained below, the different methodologies utilized by Zhang and the '866 patent result in the Petition's grounds failing to disclose or render obvious multiple claim limitations.

B. Petitioner Fails To Show "Each Digital Down Converter … Operable To Generate A Digital Channel Output Corresponding To Each Desired Channel" (Claim 14-26, 41-55, 69-82, All Grounds).

39. Limitation 14[c] recites "a plurality of digital down converters," "wherein ***each digital down converter***, of the plurality of digital down converters, is operable to ***generate a digital channel output corresponding to each desired channel***, of the plurality of desired channels." Ex. 1001 ['866] cl. 14. Independent claims 41 and 69 recite identical limitations. *Id*., cls. 41 (limitation 41[c]), 69

(limitation 69[c]). The Petition relies on Zhang alone as disclosing this limitation in all grounds. Pet. 28-29 ("Zhang thus discloses the digital downconverters of Element [14C] for the same reasons it discloses the DFE of Element[1C]"); 33 (limitation 41[c]); 54 (limitation 69[c]); Pet., 72 (claim 14); Pet., 50 (claim 41).[1] As explained below, however, the plurality of digital down converters relied upon by Petitioner in Zhang down convert both desired and undesired channels, and thus are not "***each***" "operable to generate a digital channel output ***corresponding to each desired channel***."

40. Specifically, Petitioner argues that channels C_1-C_n in Zhang disclose the claimed "desired channels." Pet., 29. Petitioner further argues and that the "n" complex multipliers in Zhang's demultiplexer 230, which down convert channels C_1-C_n, disclose the claimed "digital down converters" that are "each" "operable to generate a digital channel output corresponding to each desired channel":

> Zhang's demultiplexer 230 (below left) … include[es] a plurality of signal paths, each with a complex multiplier 320 (purple) and filter 330 (green) that are …. operable to generate "target ***channels C_1-C_n*** (light

[1] The Petition relies on its discussion of limitation 14[c] for the corresponding limitations 41[c] and 69[c]. Therefore, this POR discusses limitation 14[c] with the understanding that the same argument applies to claims 41 and 69.

blue) selected by the subscriber (***claimed "desired channels.***"). [citation]. ***Each path in Zhang is one of a "plurality of digital down converters*** … operable to generate a digital channel output corresponding to each desired channel, of the plurality of desired channels" as recited in Element [14C].

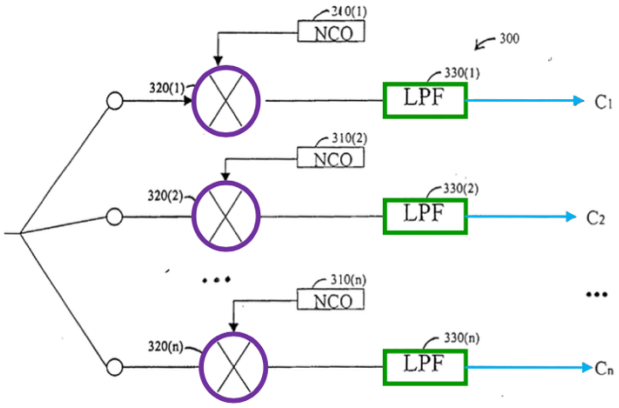


Fig. 3

Ex. 1013, Fig. 3 (annotated)

Pet., 29 (annotation Petitioner's) (internal citations omitted).

41. But, as discussed below, both Zhang and its prosecution history confirm that channels C_1-C_n encompass both desired and undesired channels. Indeed, Petitioner's mapping of Zhang's channels C_1-C_n to the claimed "plurality of desired channels" contradicts Petitioner's mapping in other claim limitations. Thus, as explained below, because channels C_1-C_n encompass both desired and undesired channels, the "n" mixers which down convert channels C_1-C_n in Zhang's channel demultiplexer 230 (purple in the annotation above), are not "each"

"operable to generate a digital channel output corresponding to each desired channel."

42. Zhang makes clear that channels C_1-C_n include both desired and undesired channels. The letter "n" in Zhang denotes the number of channels, both desired and undesired, in the "entire signal band." For example, Zhang explains:

> An ADC 220 then converts the down-converted multi-channel analog RF signal to a multi-channel digital RF signal. In this specific embodiment, ADC 220 is a high-speed ADC so that ***an entire signal band with n channels*** can be converted.

Ex. 1013 [Zhang] [0027].

43. Zhang then explains that its digital channel demultiplexer 230 demultiplexes the input RF signal into channels C_1-C_n:

> A digital channel demultiplexer 230 then demultiplexes the multi-channel digital RF signal into separate digital RF channels C_1 to C_n.

Ex. 1013 [Zhang] [0027].

44. Consequently, because "n" in Zhang denotes the total number of channels, both desired and undesired, the demultiplexed channels C_1 to C_n also include both desired and undesired channels.

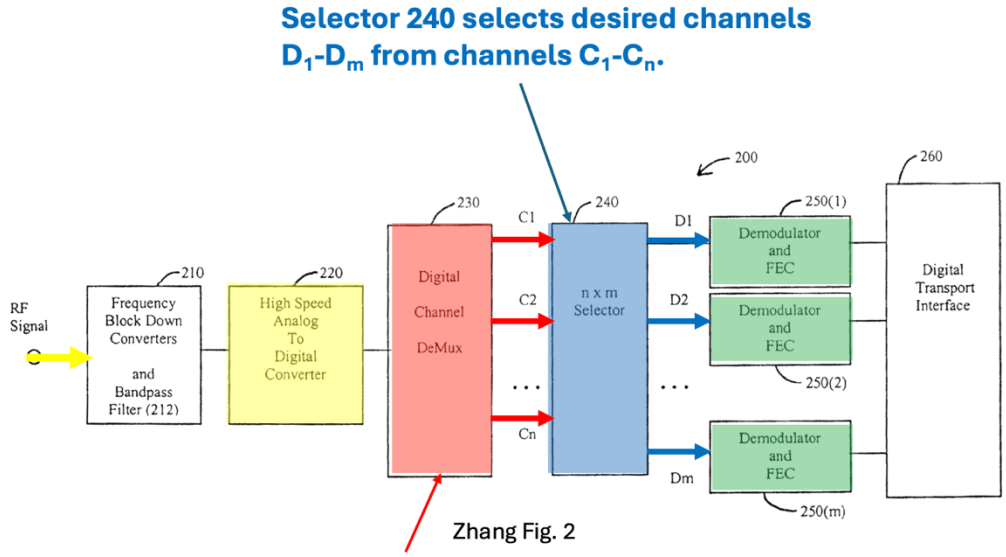
45. The balance of Zhang further confirms that channels C_1 to C_n include both desired and undesired channels. Specifically, Zhang explains that after

channels C_1-C_n are extracted from the input RF signal, an n×m selector 240 selects the desired channels D_1-D_m from the total channels C_1-C_n:

> Still referring to FIG. 2, an n×m digital selector 240 receives the demultiplexed digital RF channels C_1 to C_n ***and then selects one or more of the RF channels D_1 to D_m from one or more of the digital RF channels C_1 to C_n***. … [O]nly the selected channels are later demodulated unlike the systems using RF tuners which demodulate all of the RF channels.

Ex. 1013 [Zhang] [0028]; *see also id*., [0039] ("In operation, digital ***selector 500 digitally selects one or more RF channels D_1 to D_m from the digital RF channels C_1 to C_n and then sends them to appropriate demodulators*** or output ports (not shown) through different data buses (not shown)."); [0042] ("For example, in FIG. 6, there are 35 separate RF channels C_1 to C_{35}. Of those RF channels, 20 RF channels D_1 to D_{20} are selected. Those 20 selected RF channels are sent to a set of demodulators 650(1 … 20) for demodulation.").

46. Zhang's operation per its Figure 2, annotated below, confirms that the digital channel demultiplexer 230 demultiplexes channels C_1-C_n containing both desired and undesired channels, and n×m selector 240 selecting desired channels D_1-D_m for transmission to demodulators 250 (green):



47. Zhang's prosecution history also confirms that channels C_1-C_n encompass both desired and undesired channels, and that it is the selector that takes the extracted channels C_1-C_n as the input, and selects the desired channels D_1-D_m from the extracted channels C_1-C_n. Zhang's European Patent Application claims recited "a digital channel demultiplexer … to demultiplex the digital RF signal into separate digital RF channels (C_1 … C_n)," and "a selector … configured to receive the separate digital RF channels and to select one or more separate digital RF channels (D_1... D_m)." Ex. 2012 [Zhang-EPO-Reply] 6.

48. The European Patent Office (EPO) noted that the independent claims "appear to be not new." Exhibit 2011 [EPO-Communication-Annex] 2-3. In

response, the applicant explained that it is the selector that distinguished Zhang from its prior art, where all of the channels were demodulated:

> ***The provision of a selector allows the selection of specific RF channels for demodulation dependent on the specific application*** in which the apparatus is implemented (paragraph 37 of the application) this allows for power consumption to be optimized because only the selected channels are later demodulated ***unlike systems which demodulate all of the RF channels*** (e.g. [Reference] D1 and [Reference] D2). Thus, the invention provides apparatus which is not only faster, but also dissipates less heat, than systems such as those in D1 and D2, because fewer resources are required when demodulating only the selected RF channels (paragraph 25).

Ex. 2011 [EPO-Communication-Annex] 2-3. Subsequently, the EPO accepted the Zhang applicant's argument and allowed the claims without any further rejection. Ex. 2013 [EPO-Grant-Intent] 1.

49. A POSITA reviewing the above would recognize that from Zhang's applicant's own perspective, the digital channel demultiplexer 230, like Zhang's prior art, demultiplexed both desired and undesired channels C_1-C_n without performing any selection, and it was Zhang's selector that, unlike Zhang's prior art, only transmitted desired channels D_1-D_m to demodulators.

50. Thus, Zhang's prosecution history further confirms that channels C_1-C_n contain both desired and undesired channels.

51. Because channels C_1-C_n contain both desired and undesired channels, "each" of the "n" complex multipliers that down convert the channels C_1-C_n is not "operable to generate a digital channel output corresponding to each desired channel." As previously noted, Petitioner relies on the "n" complex multipliers in Zhang's Figure 3 for the disclosure of the claimed "plurality of digital down converters":

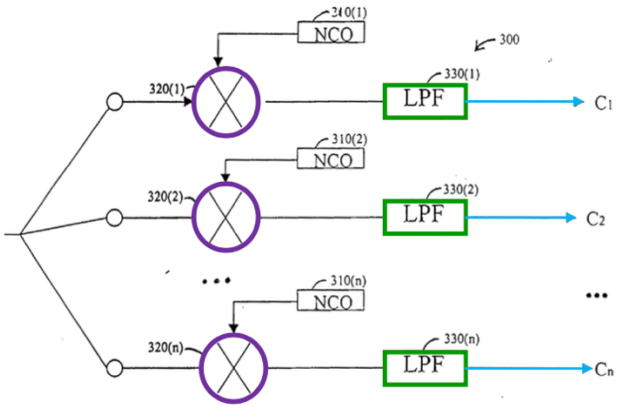


Fig. 3

Ex. 1013, Fig. 3 (annotated)

Pet., 29 (annotation Petitioner's).

52. Specifically, Zhang explains that its Figure 3 "can be used to implement digital channel demultiplexer 230 of Fig. 2." Ex. 1013 [Zhang] [0030] (relied upon by Pet., 29). In Zhang's Figure 3, there are "n" complex multipliers 320 (1…n), each of which is responsible for down converting one of channels C_1-C_n. Ex. 1013 [Zhang] [0030] ("Digital tuner 300 includes a bank of n … complex multipliers 320 (1…n) …. One chain of each of these elements is used for each RF

channel."). These "n" complex multipliers 320 (1…n) in Zhang's Figure 3 are what is relied upon by Petitioner for the disclosure of the claimed "plurality of digital down converters." Pet., 29.

Zhang, however, is clear that the output of its Figure 3 circuitry is channels C_1-C_n:

> ***Digital tuner circuit 300*** then ***outputs*** the separated RF channels ***C_1 to C_n***, each RF channel being centered at the baseband.

Ex. 1013 [Zhang] [0032].

53. Because channels C_1-C_n contain both desired and undesired channels, "each" of the "n" complex multipliers that down convert the channels C_1-C_n in Zhang's Figure 3 is not "operable to generate a digital channel output corresponding to each desired channel."

54. This is also confirmed by the number "n" of Zhang's complex multiplier 320 (1…n). As noted, Zhang discloses "n" complex multipliers 320 (1…n), each responsible for down converting one of the channels C_1-C_n. Ex. 1013 [Zhang] [0030]. As discussed above, the number "n" is the number of both desired and undesired channels in the "entire signal band." Ex. 1013 [Zhang] [0027]. Thus, the number "n" of the complex multipliers 320 (1…n) in Zhang, which is also the total number of channels, further confirms that the "n" complex multipliers

are not "each" "operable to generate a digital channel output corresponding to each desired channel."

55. Petitioner first relies on the fact that Zhang's Digital Channel DeMux 230 in an embodiment is implemented through complex mixers and argues that because the '866 patent also relies on complex mixers to extract channels, it supposedly follows that channels C_1-C_n are the claimed "desired channels," and that "each" of Zhang's mixers is "operable to generate a digital channel output corresponding to each desired channel." Pet., 29 ("Zhang's demultiplexer 230 (below left) has the same structure as the '866 patent's digital front end 230 (below right)").

56. But, as explained above, even though Zhang and the '866 patent both use complex mixers that down convert channels, unlike the'866 patent's mixers, Zhang's mixers down convert both desired and undesired channels. This is shown below by adding additional annotations (red) to Petitioner's annotation comparing Zhang Figure 3 with the '866 patent Figure 2 (at Pet., 29). As can be seen in the figures and explained in more detail below, in Zhang, the number of complex multipliers 320 (1…n) is the same number "n" as the number of all channels, both desired and undesired, in the entire signal band. In contrast, the number of mixers N in the '866 patent is the number of desired channels.

In Zhang, "n" mixers in Digital Channel DeMux 230 down convert both desired and undesired channels C_1-C_n

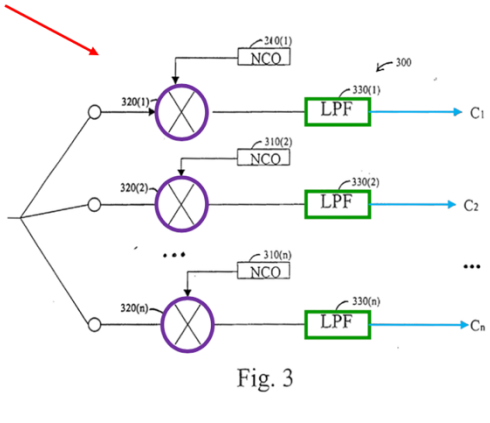
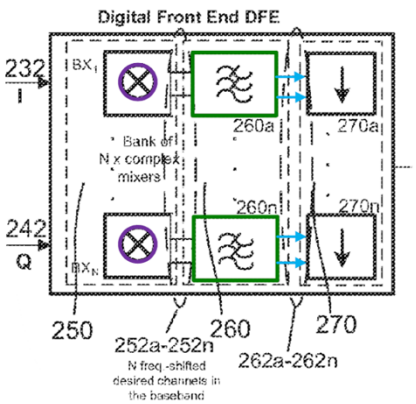


Fig. 3

Ex. 1013, Fig. 3 (annotated)

In the '866 patent, N mixers down convert N desired channels without down converting any undesired channels



Ex. 1001, Fig. 2 (excerpted/annotated)

57. At a high level, if Zhang's Figure 3 down converted and output only desired channels, there would have been no need for the subsequent channel selector 240 to select desired channels D_1-D_m from channels C_1-C_n. This is in contrast to the '866 patent's Figure 2, where the output of the Digital Front End is sent to demodulators because the down conversion in the Digital Front End is only for the desired channels. Details of Zhang's Figure 3 confirm this distinction.

58. First, in Zhang's Figure 3, there are "n" complex multipliers 320 (1…n), each used for down converting a single channel. Ex. 1013 [Zhang] [0030] ("One chain of each of these elements is used for each RF channel."). As explained above, Zhang is clear that the number "n" in its disclosure denotes all channels, both desired and undesired, in an "entire signal band." Ex. 1013 [Zhang] [0027]. Thus, the number "n" of complex multipliers 320 (1…n) has a one-to-one

correspondence with the total number "n" of desired and undesired channels, further confirming that they are not "each" "operable to generate a digital channel output corresponding to each desired channel." Second, Zhang states that the output of its Figure 3 circuitry is channels C_1 to C_n. Ex. 1013 [Zhang] [0032] ("Digital tuner circuit 300 then outputs the separated RF channels C_1 to C_n, each RF channel being centered at the baseband."). Channels C_1-C_n include both desired and undesired channels, further confirming that the "n" complex multipliers down convert both desired and undesired channels.

59. Petitioner relies upon Zhang's use of the phrase "target channel" in its discussion of Figure 3 to argue that Figure 3 only outputs desired channels. Pet., 29 (citing Ex. 1013 [Zhang] [0032]). Petitioner misapprehends Zhang's disclosure. As explained, Zhang is clear that its Figure 3 outputs both desired and undesired channels, and Petitioner is incorrect in its interpretation of Zhang's use of the phrase "target channel."

60. Specifically, in Zhang's Figure 3, annotated below, the digitized input RF signal is sent in parallel to multiple data paths, each of which is responsible for extracting one of the channels C_1-C_n from the digitized input signal. It is in this context that Zhang states that each data path is responsible for extracting its "target channel," which only means the specific one of channels C_1-C_n that the data path is responsible for. "Target channel," thus, does not refer to a "desired" channel but,

rather, a particular channel for a particular data path, which may ultimately be desired or undesired.

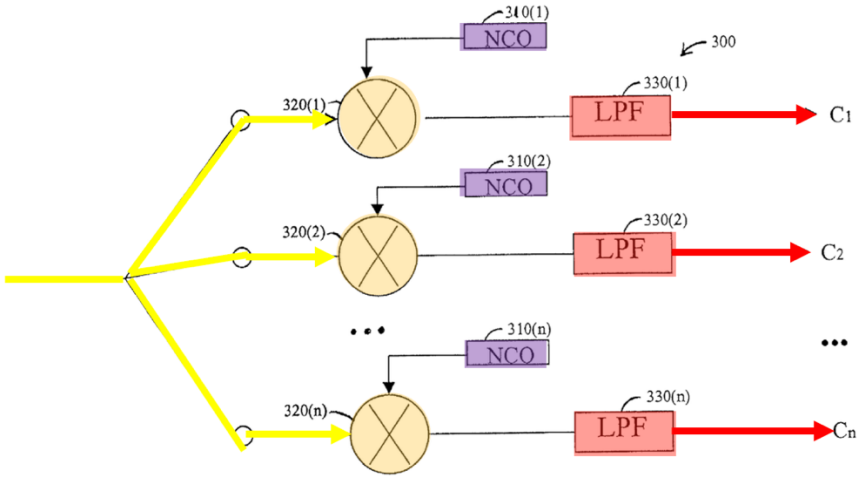


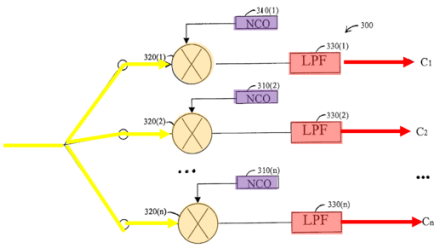
Fig. 3

61. In Zhang's Figure 3, annotated above, the digitized input RF signal (yellow) is transmitted in parallel through multiple data paths, each of which is responsible for extracting one of channels C_1-C_n. Ex. 1013 [Zhang] [0030]-[0031]. In each data path, the way a channel is extracted is that a numerical local oscillator NLO 310 (purple) provides the frequency for the one of channels C_1-C_n for which that specific data path is responsible. *Id*., [0032]. A complex multiplier 320 (orange) multiplies the digitized input RF signal with the provided frequency to down convert the channel to baseband. *Id*. Then a corresponding low pass filter LPF 330 (red) filters out all channels other than the one of C_1-C_n for that data path. *Id*. In this context, Zhang states that the complex mixer 320 (orange) is provided with the "characteristic frequency of a desired RF channel," which means the

frequency of the one of channels C_1-C_n for which this specific data path is responsible. Similarly, Zhang states that the LPF (red) only permits the "target RF channel" to pass, which, again, means the specific one of channels C_1-C_n for which this specific data path is responsible. *Id*. Nothing in Zhang's discussion of its Figure 3 changes its consistent disclosure that channels C_1-C_n contain both desired and undesired channels.

62. Petitioner also cites Zhang's claims 34, and 36-37 to argue that channels C_1-C_n contain only desired channels. Pet., 29. Claims 34, 36 and 37 depend from independent claim 28. Claim 28 claims the function of Zhang's digital channel demultiplexer in Zhang's Figure 3, which extracts both desired and undesired channels from the input signal, and recites "[a] method for demultiplexing a digital multi-channel RF signal into a plurality of separate content channels." As detailed in the table below, claims 34, 36 and 37 recite various details of Zhang's digital channel demultiplexer 230 from Zhang's Figure 3, including functions of the mixers, local oscillators and low pass filters. As noted above, however, Zhang's discussion of its Figure 3 is the ***only*** disclosure in Zhang of "target channels" and "target frequencies," and Zhang's use of these phrases does not mean selecting only desired channels as the '866 patent does. Rather, it only refers, in context, to the specific one of channels C_1-C_n (consisting of both

desired and undesired channels) for which the specific data path is responsible for extracting.

Zhang Claims	Zhang Fig. 3 (Annotated)
34. The method of claim 28 wherein the demultiplexing further comprises: **providing a plurality of select frequencies**, each select frequency being associated with a corresponding and separate RF channel; and **multiplying the at least one multi-channel RF signal** with each of the select frequencies to obtain separate RF channels. 36. The method of claim 34 further comprising **shifting the target RF channel to a baseband**. 37. The method of claim 34 further comprising **filtering undesired RF channels and passing only the target RF channel.**	 Fig. 3

63. Thus, as is clear from the above, similar to Zhang's Figure 3, "target RF channel" in Zhang's claims refers to the one of the channels C_1-C_n for which this path is responsible, and "undesired RF channels" refers to the remaining ones of channel C_1 to C_n other than the one for which this path is responsible.

64. Petitioner also relies on Zhang's statement that "RF channels C_1 to C_n contain channels that are selected or used by a subscriber." Pet., 25 (citing Exhibit 1013 [Zhang] [0028]). That portion of Zhang does not state that channels C_1 to C_n

contain "only" desired channels. Instead, in context, reproduced below in full, this statement simply means that the "channels that are selected or used by a subscriber" are contained within the broader set of "RF channels C_1 to C_n." Consistent with this, Zhang states that channels C_1 to C_n contain all channels in the entire signal band, from which actual desired channels D_1 to D_m can be selected:

> Still referring to FIG. 2, an n×m digital selector 240 receives the demultiplexed digital RF channels C_1 to C_n and then selects one or more of the RF channels D_1 to D_m from one or more of the digital RF channels C_1 to C_n. RF channels C_1 to C_n contain content channels that are selected or used by a subscriber. Channel-search capabilities of the digital selector 240 renders it much faster than traditional analog channel switching through RF tuners.

Ex. 1013 [Zhang] [0028].

65. Not only is Petitioner's assertion that Zhang's channels C_1-C_n disclose the claimed "desired channels" incorrect and contrary to Zhang's disclosure, it is also inconsistent with Petitioner's mapping of Zhang to other claim limitations.

66. For example, limitation 14[d] recites "wherein the plurality of digital down converters is operable to provide each digital channel output via a serial interface." Petitioner relies on Data Bus 1 within Zhang's n×m selector 240 as disclosing a serial interface (Data Bus 1) via which the plurality of down

converters "provide" the "plurality of desired channels." Pet., 31. Zhang's n×m selector 240 is reproduced below with annotations added:

Figure 5 "**selects one or more RF channels D_1 to D_m from the digital RF channels C_1 to C_n** and then **sends them** to appropriate demodulators or outputs ports ... **through different data buses** ...." Ex. 1013 [Zhang] [0039]

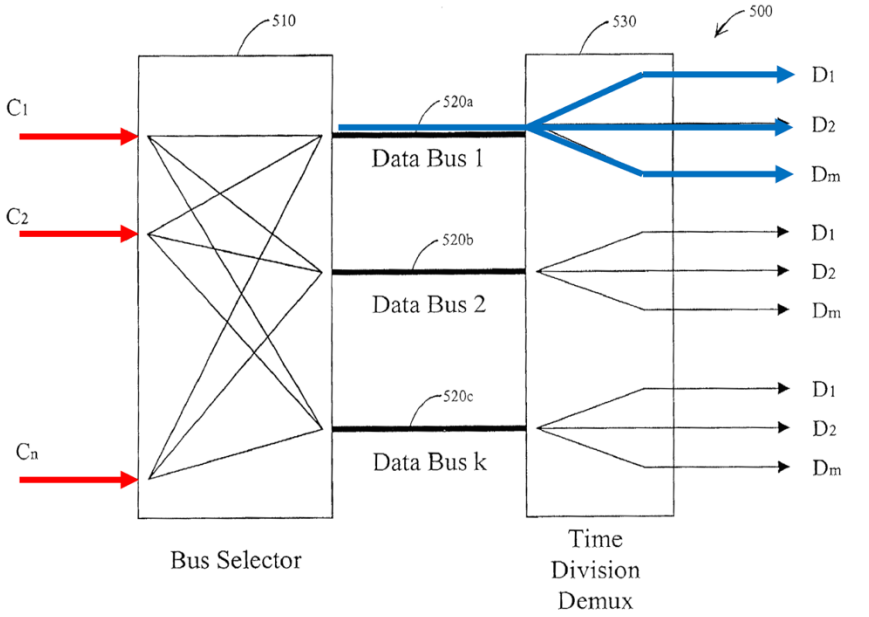


Fig. 5

67. As is clear from Zhang's Figure 5, what is "provided" on Data Bus 1 in the selector 240 are channels D_1-D_m (blue) shown on the right-hand side output of data bus 1, not channels C_1-C_n (red). This is consistent with the balance of Zhang's disclosure that explains the digital selector in Fig. 5 "selects one or more RF channels D_1 to D_m from the digital RF channels C_1 to C_n and then sends them to appropriate demodulators or outputs ports …." Ex. 1013 [Zhang] [0039].

68. Thus, to the extent Petitioner's mapping of limitation 14[c] relies on Zhang's channels C_1-C_n as the claimed "plurality of desired channels," and on

Zhang's complex multipliers 320 (1…n) for the disclosure of the claimed down converters that are "each" "operable to generate a digital channel output corresponding to each desired channel," that mapping contradicts Petitioner's mapping for limitation 14[d], where Petitioner must rely on channels D_1-D_m as "the plurality of desired channels" output by down converters via a serial bus.

69. For all of the foregoing reasons, Petitioner's reliance on Zhang's channels C_1-C_n as the "plurality of desired channels," and on Zhang's complex multipliers 320 (1…n) as the claimed "plurality of digital down converters" fails.

C. Petitioner Fails To Show A "DFE … Configured To Concurrently Select And Provide Each Of The Plurality Of Desired Channels." (Claims 1-13, 27-40, 55-68, All Grounds).

70. Limitation 1[c] requires a "***DFE*** [Digital Front End] … configured to ***concurrently select and provide each of the plurality of desired channels*** without providing any of the plurality of undesired channels." Ex. 1001 ['866] cl. 1. Independent claims 27 and 55 recite identical limitations. *Id*., cls. 27 (limitation 27[c]), 55 (limitation 55[c]). Petitioner contends that Zhang alone discloses this

limitation. Pet., 26 ("Zhang thus discloses element 1[c]"); 32-33 (limitation 27[c]); 51 (limitation 55[c]); 50 (claim 27); 72 (claim 1).[2]

71. Specifically, Petitioner argues that Zhang's "Demultiplexer 230 and a portion of Digital Selector 240" discloses the claimed "digital frontend (DFE)," providing an annotated Figure 2 reproduced below:

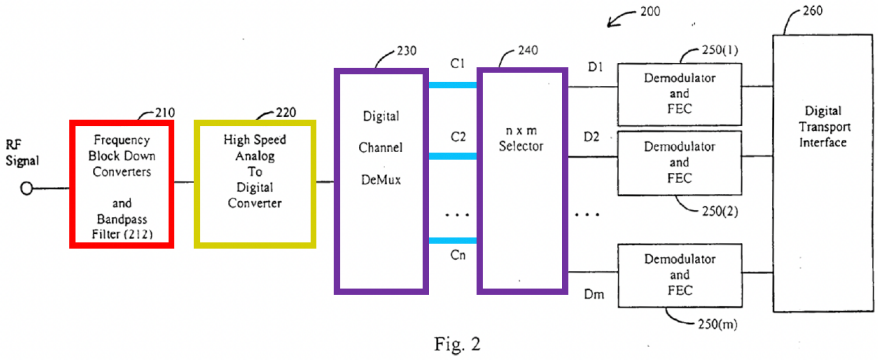


Fig. 2

Ex. 1013, Fig. 2 (annotated)

Pet., 22 (annotation Petitioner's).

72. Petitioner argues that in Zhang's Figure 2, the Digital Channel Demultiplexer 230 "select[s] a plurality of desired channels C_1-C_n" (Pet., 23), and Selector 240 "provides 'm' channels D_1-D_m" (Pet., 24).

[2] The Petition relies on its discussion of limitation 1[c] for the corresponding limitations 27[c] and 55[c]. Therefore, this POR discusses limitation 1[c] with the understanding that the same argument applies to claims 27 and 55.

73. Petitioner's argument fails because Zhang's channels C_1-C_n are not "desired channels," and Zhang's Digital Channel Demultiplexer 230 does not "select" any desired channels. Rather, channels C_1-C_n encompass all channels in the entire signal band, and the Demultiplexer 230 blindly demultiplexes all channels into separate channels without performing any selection.

74. I also note that to the extent Petitioner relies on Zhang's Selector 240 to perform any function of the claimed "digital front end," I have not seen any analysis by Mr. Lett on why Zhang's selector 240 would be a part of the claimed digital front end. Therefore, Petitioner has not provided any analysis that I can respond to. To the extent any analysis is provided by Petitioner in the future, I reserve the right to supplement my opinions to respond to any new analysis.

75. As noted, limitation 1[c] requires a "DFE … configured to concurrently ***select*** and provide ***each of the plurality of desired channels*** without providing any of the plurality of undesired channels." Ex. 1001 ['866] cl. 1. Petitioner argues that Zhang's channels C_1-C_n disclose the claimed "plurality of desired channels," and Zhang's Channel Demultiplexer 230 performs the claimed "selecting" of the plurality of desired channels:

> ***Digital tuner 300 (an embodiment of demultiplexer 230)*** (below left) has the same structure as the '866 patent's digital front end 230 (below right), including multiple signal paths for concurrently ***selecting*** and providing ***a plurality of desired channels C_1-C_n*** (light blue).

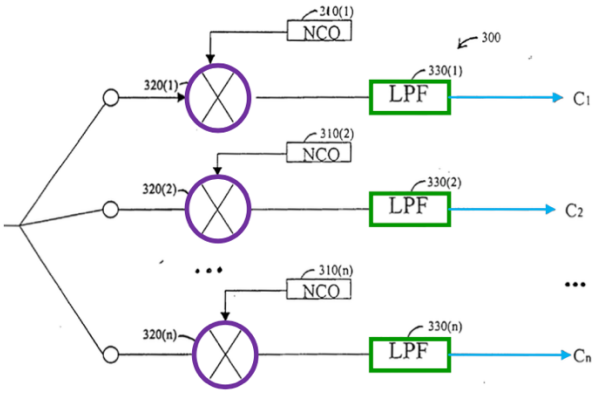


Fig. 3

Ex. 1013, Fig. 3 (annotated)

Pet., 23 (Petitioner's annotation); *see also* Ex. 1002 [Lett-Decl.] ¶¶ 110-111 (similar).

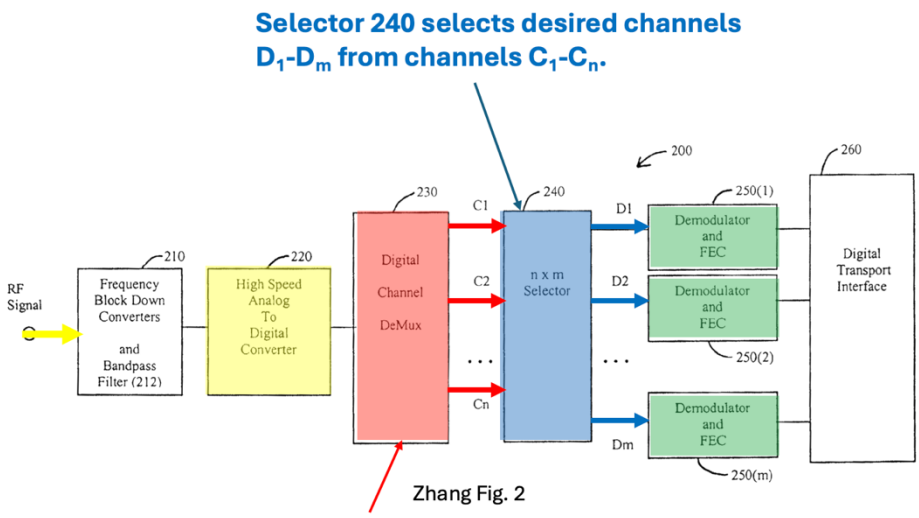
76. However, for the reasons discussed above, incorporated by reference here, and summarized below, channels C_1-C_n in Zhang are not a "plurality of desired channels." Similarly, Zhang's Demultiplexer 230 does not "select" any desired channels; rather, it demultiplexes all channels, both desired and undesired, without performing any selection.

77. As explained in paragraphs 42-46 in connection with Claim 14, Zhang teaches that the letter "n" in Zhang denotes the number of channels, both desired and undesired, in the "entire signal band." Ex. 1013 [Zhang] [0027]. Zhang further explains that its digital channel demultiplexer 230 demultiplexes the input RF signal into channels C_1-C_n. Ex. 1013 [Zhang] [0027]. Consequently, because "n" in Zhang denotes the total number of channels, both desired and undesired, the

demultiplexed channels C_1 to C_n, therefore, also include both desired and undesired channels.

78. As further explained in paragraphs 42-46, Zhang teaches that after channels C_1-C_n are extracted from the input RF signal, an n×m selector 240 selects the desired channel D_1-D_m from the total channels C_1-C_n. Ex. 1013 [Zhang] [0028]; *see also id*., [0039] ("In operation, digital ***selector 500 digitally selects one or more RF channels D_1 to D_m from the digital RF channels C_1 to C_n and then sends them to appropriate demodulators*** or output ports (not shown) through different data buses (not shown)."); [0042] ("For example, in FIG. 6, there are 35 separate RF channels C_1 to C_{35}. Of those RF channels, 20 RF channels D_1 to D_{20} are selected. Those 20 selected RF channels are sent to a set of demodulators 650(1 … 20) for demodulation.").

79. I schematically showed the operation of Zhang through an annotation of its Figure 2, reproduced below:



Digital Channel DeMux 230 extracts all channels C_1-C_n, both desired and undesired, from the digitized input RF signal.

80. As further explained in paragraphs 47-49, a POSITA reviewing Zhang's prosecution history would also understand that, from the perspective of Zhang's own applicant, channels C_1-C_n encompass all channels, both desired and undesired.

81. As explained in paragraphs 42-49 and summarized above, therefore, Zhang's Digital Channel Demultiplexer 230, which demultiplexes channels C_1-C_n from the digitized RF input signal, does not perform any "selection" because channels C_1-C_n encompass all channels in the "entire signal band." Ex. 1013 [Zhang] [0027].

82. As also explained in paragraphs 55-61, Petitioner's reliance on Zhang's Figure 3 to implement the Digital Channel Demultiplexer 230 does not change Zhang's operation. Zhang explains that its Figure 3 "can be used to

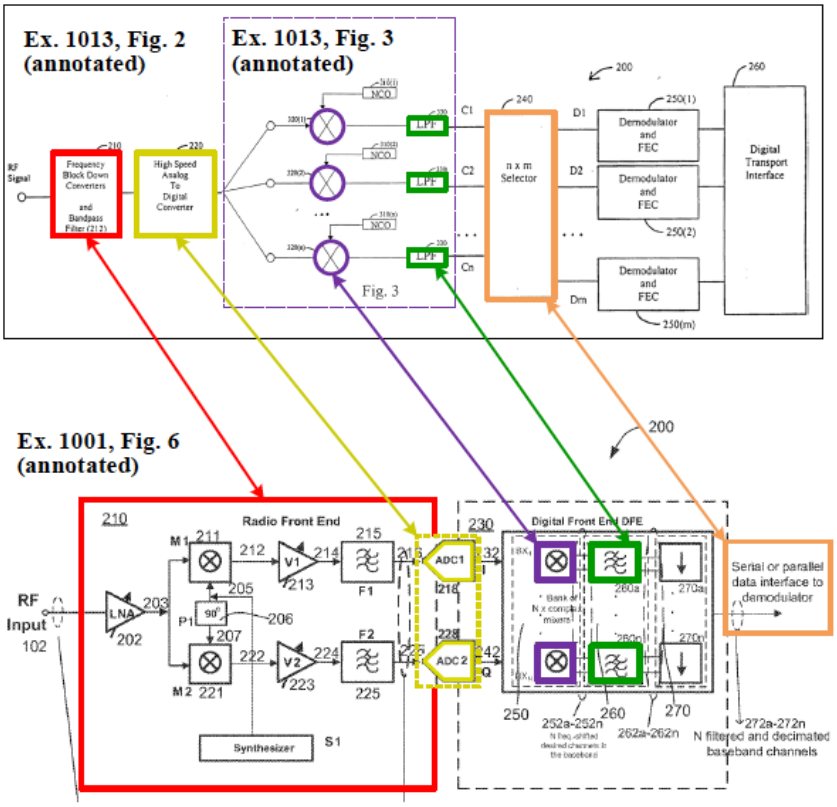
implement digital channel demultiplexer 230 of Fig. 2." Ex. 1013 [Zhang] [0030] (cited at Pet., 25). The output of Zhang's Figure 3 circuitry is channels C_1 to C_n. Ex. 1013 [Zhang] [0032] ("Digital tuner circuit 300 then outputs the separated RF channels C_1 to C_n, each RF channel being centered at the baseband."). Thus, Zhang's Digital Channel Demultiplexer 230, whether implemented through Zhang's Figure 3 or otherwise, does not disclose "selecting" any desired channels. Rather, it blindly demultiplexes all channels C_1-C_n in the "entire signal band." Ex. 1013 [Zhang] [0027].

83. Therefore, for the foregoing reasons, Petitioner has not shown disclosure or obviousness of a "DFE … configured to concurrently ***select*** and provide ***each of the plurality of desired channels***."

84. As I noted above, to the extent Petitioner relies on Zhang's Selector 240 to perform any function of the claimed "digital front end," I have not seen any analysis as to why Zhang's Selector 240 discloses the claimed "digital front end," and therefore, I have not seen any analysis to respond to.

85. I note that several mappings of Zhang to the embodiments of the '866 patent that are provided by Petitioner suggest that Zhang's Selector 240 is not a part of the claimed "digital front end." For example, Mr. Lett's overview of Zhang shows only Digital Channel Demultiplexer 230 as corresponding to the '866

patent's Digital Front End (DFE), with Zhang's Digital Selector 240 corresponding to the ***output*** of the DFE:



Ex. 1002 [Lett-1st-Decl.] ¶ 79.

86. In the annotation provided by Mr. Lett above, the upper figure is Zhang's Figure 2, and the lower figure is Figure 6 of the '866 patent. In Figure 6 of the '866 patent (lower figure), the dotted box on the right-hand side of the figure is labeled "Digital Front End DFE" 230. As can be seen above, Mr. Lett has mapped Zhang's Selector 240 (upper figure) using the color orange to the arrow titled "serial or parallel data interface to demodulator" that is output from the

digital front end 230 in the ’866 patent (dotted box in the lower figure). Thus, Mr. Lett has mapped Zhang’s selector 240 to the ***output*** of the ’866 patent’s digital front end (DFE).

87. At deposition, Mr. Lett confirmed that he is mapping Zhang’s Selector 240 to the “output” of the claimed “digital front end” in the ’866 patent, and further opined that it is “more logical” to do so:

> Q. Now, why did you map … the n×m selector 240 in Zhang to the output of the Digital Front End DFE arrow titled serial or parallel to demodulator in Figure 6 of the '866 patent?
>
> A. Because the n×m selector outputs serial or parallel interface to a demodulator.
>
> Q. That’s the one that you said is like a switch; right?
>
> A. Among other things.
>
> …
>
> Q. ***What is the basis of your opinion that the n×m Selector 240 in Zhang is analogous to the output of the digital front end 230 in Figure 6 of the ’866 patent?***
>
> A. As we’ve been talking about—and we can go through it in more detail if you want—the n×m selector—***n×m selector can output serial or parallel data to a demodulator.***
>
> Q. Is that it?
>
> A. Yes.

Q. So in your opinion, ***would it be wrong to map the n×m selector 240 from Zhang to the output of filters 260 within the digital front end in Figure 6 of the '866 patent?***

A. Well, the output of the Figure 6 annotated below is on the right side. ***And what we're mapping to is the output to demodulators. So it is more logical to map that to the output.*** And then we come along later and explain the decimation.

Ex. 2018 [Lett-1st-Depo.-Volume-I] 145:16-147:13.[3]

88. Petitioner made a similar mapping when it compared Zhang's Figure 3 embodiment (which implements only Zhang's digital channel demultiplexer 230) with the digital front end in the '866 patent's Figure 2. Pet., 23. Specifically, Petitioner argued that:

> ***Digital tuner 300*** (an embodiment of demultiplexer 230) (below left) ***has the same structure as the '866 patent's digital front end 230*** (below right), including multiple signal paths for concurrently selecting and providing a plurality of desired channels C_1-C_n (**light blue**). *Compare* Ex. 1013, Fig. 3 (filters 330), [0030]-[0034], claims 34, 36-37 *with* Ex. 1001, Fig. 2 (filters 260), 6:3-8; Ex. 1002, ¶ 110. Like the '866 patent's DFE, each path includes a complex multiplier 320 (**purple**) followed by a low pass filter (LPF) 330 (**green**).

[3] Objections by counsel are omitted.

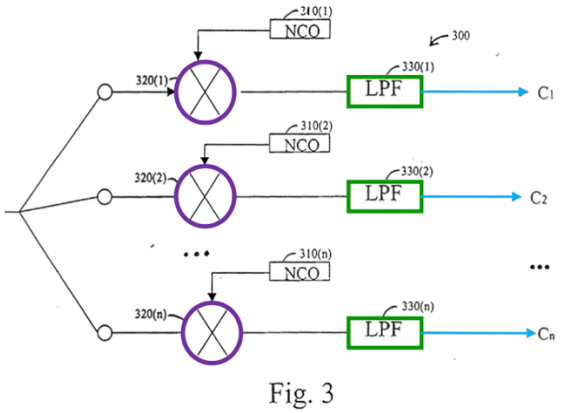
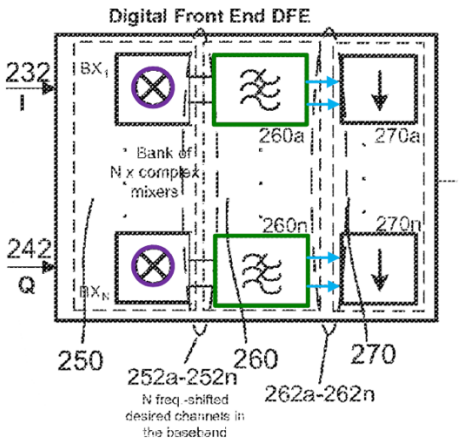


Fig. 3

Ex. 1013, Fig. 3 (annotated)



Ex. 1001, Fig. 2 (annotated)

Pet., 23 (annotation Petitioner's).

89. Notably, the digital tuner 300 in Zhang, which Petitioner argues "has the same structure as the '866 patent's digital front end," is an implementation of Zhang's digital channel demultiplexer 230, not Zhang's Selector 240. Ex. 1013 [Zhang] [0030] ("FIG. 3 is a simplified high-level schematic diagram of a digital tuner 300, which in some embodiments of the present invention, can be used to implement digital channel demultiplexer 230 of FIG. 2."). Petitioner provides no explanation as to why and how Zhang's selector 240 is a part of the claimed "digital front end (DFE)."

90. For the foregoing reasons, I have not seen any analysis from Petitioner as to why Zhang's Selector 240 discloses the claimed "digital front end."

91. Petitioner, thus, has failed to demonstrate disclosure or obviousness of a "digital front end (DFE)" that "provide[s] a plurality of desired channels … without providing any of the plurality of undesired channels."

VII. CONCLUSION

92. For the foregoing reasons, based on my expertise and experience and the record of this case that I have reviewed, it is my opinion that the challenged claims are not shown to be disclosed or obvious.

93. I understand that my opinions discussed above support a legal conclusion that the challenged claims are nonobvious.

In signing this declaration, I recognize that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required, I will appear for cross-examination within the United States during the time allotted.

I hereby declare that all statements made herein of my own knowledge are true and all statements made herein on information and belief were and are believed by me to be true, and that all statements herein were and are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code and that any such willful false statements may jeopardize the validity of the application or any patents issued thereon.

Respectfully submitted,

Dated: January 14, 2025

Samuel H. Russ, Ph.D.