

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

COMCAST CABLE COMMUNICATIONS, LLC,
Petitioner

v.

ENTROPIC COMMUNICATIONS, LLC.,
Patent Owner.

Patent No. 11,381,866
Filing Date: January 28, 2022
Issue Date: July 5, 2022
Title: CABLE TELEVISION DEVICE

Inter Partes Review No.: IPR2024-00435

Declaration of David B. LETT

**in support of PETITION FOR *INTER PARTES* REVIEW
UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. § 42.100 *et seq.***

TABLE OF CONTENTS

1.	Introduction.....	1
2.	Professional Background And Qualifications.....	1
3.	Materials Considered	7
4.	Understanding Of Applicable Legal Standards	10
5.	The Relevant Art And Level Of Ordinary Skill In The Relevant Art	15
6.	Claim Construction	17
7.	OVERVIEW OF THE '866 PATENT.....	21
	7.1. Prosecution History	22
	7.2. Earliest Priority Date for the Claims	24
8.	OVERVIEW OF THE PRIOR ART	24
	8.1. Cable and Satellite Television Networks	24
	8.2. Modulated RF Signals	27
	8.3. Radio Receivers or Tuners for Cable and Satellite Television Networks	32
	8.4. Serial vs. Parallel Data Communication	48
	8.5. U.S. Publication No. 2003/0056221 – Zhang (Ex. 1013).....	50
	8.6. U.S. Pub. No. 2003/0229900 – Reisman (Ex. 1052)	54
	8.7. U.S. Pub. No. 2009/0113504 – Jackson (Ex. 1057).....	56
	8.8. U.S. Patent No. 7,237,214 – Pandey (Ex. 1014).....	57
9.	OPINIONS WITH RESPECT TO THE '866 PATENT.....	60
	9.1. Summary of the Grounds and Comparison of Claim Limitations	60
	9.2. Ground A/B: Zhang (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)	65
	9.3. Ground C: Zhang-Reisman (Claims 10-12, 23-25, 27, 33, 35-41, 47, 49-55, 61, 63-69, 75, and 77-82).....	107
	9.4. Ground D: Zhang-Jackson (Claims 2-6, 15-19, 28-32, and 42- 46), Ground E: Zhang-Reisman-Jackson (Claims 28-32, 42-46, 56-60 and 70-74)	122

9.5.	Ground F: Zhang-Pandey (Claims 1, 3-9, 11, 13, 14, 16-22, 24, 26, 34-36, and 48-50), and Ground G: Zhang-Reisman-Pandey (Claims 9-12, 22-25, 34-36, 48-50, 62-64, and 76-78).....	137
9.6.	Zhang in view Pandey and Jackson Render Claims 2-6 and 15-19 Obvious (Ground H).....	145
10.	CONCLUSION	146
11.	CLAIMS LISTING APPENDIX.....	147

I, David B. Lett, declare that I have personal knowledge of the facts set forth in this declaration and, if called to testify as a witness, could and would do so competently.

1. Introduction

1. I have been retained as an expert witness on behalf of the Petitioner, Comcast Cable Communications, LLC, for the above-referenced *inter partes* review proceeding.

2. I have been asked to provide a declaration regarding certain matters pertaining to U.S. Patent No. 11,381,866 (“the ’866 patent”) (Ex. 1001) and the unpatentability grounds set forth in the Petition for this proceeding. My experience with television distribution systems, Set Top Boxes (STBs), modulation schemes, radio frequency systems, Video on Demand (VOD), and content delivery systems provides me with an understanding of the subject matter described and claimed in the ’866 patent.

3. I am being compensated at my usual consulting rate or testimony rate of \$385 per hour. My compensation is in no way dependent upon my opinions or testimony or the outcome of this proceeding. I have no financial interest in the party or in the outcome of this proceeding.

2. Professional Background And Qualifications

4. I am a technical consultant and product development industry veteran with expertise in electronics, software, hardware, video, audio, and data

communications, having led product development organizations in cable, satellite, consumer electronics, home automation, asset tracking, remote tank logistics, and alarm industries. My current curriculum vitae is attached as Ex. 1003 and some highlights follow.

5. I earned my B.S. in Electrical Engineering (1982) with high honors from the University of Tennessee in Knoxville, Tennessee. I also attended the Georgia Institute of Technology from 1986 to 1987, completing 40% of the required degree hours for the M.S. Electrical Engineering program.

6. From 1982 to 1985, I worked at Scientific Atlanta as an Electrical Engineer designing video, audio, and data communications equipment for the cable television industry. I designed software and hardware including addressable data transmitters, video sync suppression scramblers, transaction format converters, and data channel monitors for addressable Cable Television systems and Set Top Boxes.

7. From 1983 to 1985, while working at Scientific Atlanta, I also worked as an Assistant Professor at DeVry Institute of Technology, teaching courses in electronics and microprocessor hardware/software.

8. From 1985 to 1990, I worked at Wegener Communications as a Senior Electrical Engineer, designing satellite communications equipment including forward error correction (FEC) coding systems, PSK modems, and analog control systems for RF modulators and PSK demodulators. I was promoted to the Hardware

Engineering Manager, where I managed product development of video, audio, and data satellite receivers, modulators, graphics display systems, DSP-based companders, FSK and PSK satellite modems, multiplexers, forward error correction (FEC) codecs, RF upconverters and downconverters, and baseband analog and digital processing components.

9. In 1990, I returned to Scientific Atlanta, which was acquired by Cisco in 2006. I worked as Engineering Manager running the set top box engineering group where I was promoted to Director and Vice President during my tenure until 2011. I led the design of many cable set top boxes and systems through the evolution of analog video, addressability, downloadable software, electronic program guides, digital video, VOD, software applications, high-definition TV, DVR, DOCSIS, full spectrum tuners, and multiroom DVR. These systems implemented various technologies including DOCSIS 1/2/3 and hybrid gateways, 802.11, IPTV, DVR, cable modems, ADSL, VDSL, DVB-T/C/S, bootloaders, factory diagnostics, application frameworks, Nagra, DRMs, conditional access, secure microprocessors, device management, Android, Adobe Flash, Linux, DVD play/record, MPEG-4, MPEG-2, H.264, NTSC, PAL, DAVIC, MoCA, high-performance CPUs, cablecards, network processors, HDMI, multiple video/audio display interfaces, 2D/3D graphics, multiple RF tuners, and full spectrum tuners.

10. From 2011 to 2016, I worked for EchoStar Technologies, which served as the product development organization for sister company DISH Network. I served as Vice President of Engineering and was the Head of the Atlanta research and development center. I led the development of satellite set top boxes, consumer electronic equipment, and a home automation and security system. Technologies used included video/audio, IoT, H.265, HEVC, 3D, Satellite, wireless, MoCA, transcoding, embedded C Linux applications, mobile applications (IOS and Android), SaaS, web applications (Javascript, HTML), BSS/OSS, AWS cloud storage, 2-way video/audio streaming, authentication, and VoIP.

11. In 2016, I started an independent consulting business in technology and intellectual property projects. I have consulted in various technology areas and industries including consumer electronics, Internet of Things (IoT), cable, satellite, television, media, and cryptocurrency.

12. From 2019 to 2022, I worked as Chief Technology Officer for Telular, an Ametek company. I was responsible for the development of Industrial Internet of Things (IIoT) recurring revenue solutions, combining wireless technologies, purpose-built hardware, and SaaS in the commercial telematics, security and home automation markets and sold under the SkyBitz and Telguard brands.

13. My record of professional service includes awards on products I designed and developed from several organizations in my field of expertise, including Best of Show, Technology Emmy, and Best of Innovations.

14. I am a named inventor on at least 87 patents and published patent applications corresponding to the areas of my professional work. The patents and published applications involving video and audio technologies include:

- U.S. Patent No. 9,882,736 titled “Remote Sound Generation for a Home Automation System”
- U.S. Patent No. 9,615,139 titled “Determining Device That Performs Processing of Output Pictures”
- U.S. Patent No. 8,549,567 titled “Media Content Sharing Over a Home Network”
- U.S. Patent No. 8,161,388 titled “Interactive discovery of display device characteristics”
- U.S. Patent Nos. 8,120,924, 7,240,217, 6,785,817, 6,564,324, 6,212,278, and 5,440,632 titled “Reprogrammable Subscriber Terminal”
- U.S. Patent No. 7,908,625 titled “Networked Multimedia System”
- U.S. Patent Nos. 7,861,272 and 7,849,486 titled “Networked Subscriber Television Distribution”

- U.S. Patent Nos. 7,774,820 and 7,069,578 titled “Settop Cable Television Control Device and Method Including Bootloader Software and Code Version Table for Maintaining and Updating Settop Receiver Operating System Software”
- U.S. Patent No. 5,771,064 titled “Home Communications Terminal having an Applications Module”
- U.S. Patent No. 5,715,515 titled “Method and Apparatus for Downloading On-Screen Graphics and Captions to a Television Terminal”
- U.S. Patent No. 5,657,414 titled “Auxiliary Device Control for a Subscriber Terminal”
- U.S. Patent No. 5,592,551 titled “Method and Apparatus for Providing Interactive Electronic Programming Guide”
- U.S. Patent No. 5,539,822 titled “System and Method for Subscriber Interactivity in a Television System”
- U.S. Patent No. 5,357,276 titled “Method of Providing Video On Demand with VCR Like Functions”
- U.S. Patent Application Publication Nos. 2004/0068753 and 2008/0072272 titled “Video Transmission Systems and Methods for a Home Network”
- U.S. Patent Application Publication No. 2004/0133911 titled “Subscriber Network in a Satellite System”

15. I have a general understanding of the U.S. patent prosecution process and of the novelty and non-obviousness requirements for patentability.

16. I believe that my extensive industry experience and educational background qualify me as an expert in the relevant field of digital signal processing (DSP) and radio frequency (RF) tuning systems for satellite and/or cable communications. I am knowledgeable of the relevant skill set that would have been possessed by a hypothetical person of ordinary skill in the art at the time of the invention of the '866 patent, which I (as I discuss below) understand is early 2009 or early 2010.

3. Materials Considered

17. In formulating my opinion, I reviewed and considered the '866 patent (U.S. Pat. No. 11,381,866 to Reddy, et al.) (Ex. 1001), as to which I am offering my opinion regarding the validity of certain claims, as discussed herein.

18. In preparing this declaration, I also reviewed and considered the Petition and the file history of the '866 patent (included in Ex. 1004) as well as the following references:

Ex. 1001: U.S. Patent No. 11,381,866 (“the '866 patent”)

Ex. 1003: Curriculum Vitae of David B. Lett

Ex. 1004: Certified Prosecution History of the '866 patent

- Ex. 1007: Certified Prosecution History of U.S. Provisional App. No. 61/170,526 (“526 provisional”)
- Ex. 1013: U.S. Pub. No. 2003/0056221 (“Zhang”)
- Ex. 1014: U.S. Patent No. 7,237,214 (“Pandey”)
- Ex. 1015: Excerpts of “IEEE Std 100-2000, The Authoritative Dictionary of IEEE Standards Terms, Seventh Edition” (IEEE Press. 2000) (“IEEE Std 100”)
- Ex. 1016: Excerpts of Jan M Rabaey, “Digital Integrated Circuits: A Design Perspective” (Pearson, 2nd ed. 2002) (“Rabaey”)
- Ex. 1017: A. P. Chandrakasan, “Ultra low power digital signal processing,” Proceedings of 9th International Conference on VLSI Design, Bangalore, India, 1996, pp. 352-357 (“Chandrakasan”)
- Ex. 1018: S. Mirabbasi and K. Martin, “Classical and Modern Receiver Architectures,” IEEE Communications Magazine, vol. 38, no. 11, pp. 132-139, November 2000 (“Mirabbasi”)
- Ex. 1019: U.S. Patent No. 6,061,406 (“Carson”)
- Ex. 1021: Data-Over-Cable Service Interface Specifications, DOCSIS 2.0, Radio Frequency Interface Specification, CM-SP-RFIV2.0-I11-060602
- Ex. 1025: J. Crols and M. S. J. Steyaert, “Low-IF topologies for high-performance analog front ends of fully integrated receivers,” IEEE Transactions on Circuits and Systems II: Analog and Digital Signal Processing, vol. 45, no. 3, pp. 269-282, March 1998 (“Crols”)
- Ex. 1027: U.S. Patents and Patent Applications Family Tree for U.S. Pat. 11,381,866

- Ex. 1033: Excerpts of W. Ciciora, J. Farmer, D. Large, and M. Adams, “Modern Cable Television Technology: Video, Voice, and Data Communications” (2nd ed. 2004) (“Ciciora”)
- Ex. 1034: Excerpts of J. Crols and M. Steyaert, “CMOS Wireless Transceiver Design” (1997)
- Ex. 1035: U.S. Patent No. 7,340,230 (“Khoini-Poorfard”)
- Ex. 1036: U.S. Pub. No. 2003/0217362 (“Summers”)
- Ex. 1037: U.S. Pub. No. 2006/0256799 (“Eng”)
- Ex. 1038: U.S. Pub. No. 2006/0083335 (“Seendripu”)
- Ex. 1039: Excerpts of Chris Bowick, “RF Circuit Design” (2nd ed. 2008)
- Ex. 1041: Excerpts of Roland Priemer, “Introductory Signal Processing” (1991)
- Ex. 1042: U.S. Patent No. 7,272,375 (“Tuttle”)
- Ex. 1043: U.S. Patent No. 7,130,576 (“Gurantz”)
- Ex. 1044: U.S. Patent No. 5,278,837 (“Kelly”)
- Ex. 1045: Jeffrey Hugh Reed, “Software Radio: A Modern Approach to Radio Engineering” (2002)
- Ex. 1046: U.S. Patent No. 7,213,042 (“Cannon”)
- Ex. 1048: Excerpts of William Buchanan, “Computer Busses” (2000)
- Ex. 1049: U.S. Patent No. 7,079,528 (“Ziegler”)
- Ex. 1050: Excerpts of “Software Defined Radio: Enabling Technologies” (Walter H.W. Tuttlebee ed., 2003)
- Ex. 1051: U.S. Pub. No. 2005/0183015 (“Dunton”)

Ex. 1052: U.S. Pub. No. 2003/0229900 (“Reisman”)

Ex. 1057: U.S. Pub. No. 2009/0113504 (“Jackson”)

Ex. 1073: Expert Declaration of Dr. Sylvia Hall-Ellis

Ex. 1074: Reserved

Ex. 1075: U.S. Patent No. 6,791,995 (“Azenkot”)

Ex. 1076: U.S. Patent No. 6,542,203 (“Shadwell”)

4. Understanding Of Applicable Legal Standards

19. Although I am not an attorney, I have a general understanding of the applicable legal standards pertaining to the patentability issues presented in this proceeding. I understand that the Petitioner is challenging the patentability of the claims of the ’866 patent based on the following grounds:

Ground	References	Basis	Claims Challenged
A	Zhang	35 U.S.C. §102 (anticipation)	1, 3-7, 9, 11, 13, 14, 16-20, 22, 24, 26, 27, 29-33, 35-37, 40, 41, 43-47, 49-51, 54

B	Zhang	35 U.S.C. §103 (obviousness)	1, 3-7, 9, 11, 13, 14, 16-20, 22, 24, 26, 27, 29-33, 35-37, 40, 41, 43-47, 49-51, 54
C	Zhang-Reisman	35 U.S.C. §103 (obviousness)	9-12, 22-25, 27, 29-33, 35-40, 41, 43-47, 49-54, 55, 57-61, 63-68, 69, 71-75, 77-82
D	Zhang- Jackson	35 U.S.C. §103 (obviousness)	2-6, 15-19, 28-32, 42-46
E	Zhang-Reisman- Jackson	35 U.S.C. §103 (obviousness)	28-32, 42-46, 56-60, and 70-74
F	Zhang-Pandey	35 U.S.C. §103 (obviousness)	1, 3-9, 11, 13, 14, 16-22, 24, 26, 34-36, 48-50
G	Zhang-Reisman- Pandey	35 U.S.C. §103 (obviousness)	9-12, 22-25, 34-36, 48-50, 62-64, 76-78
H	Zhang-Pandey- Jackson	35 U.S.C. §103 (obviousness)	2-6, 15-19

20. I understand that, in this *inter partes* review, Petitioner has the burden of proving that each challenged claim is unpatentable by a preponderance of the evidence.

21. I understand that to be valid, a patent claim must be “novel,” and is invalid if “anticipated” by a single prior art reference. I further understand a reference anticipates if it discloses each and every element as arranged in the claim so as to enable a person of ordinary skill in the art to make and use the claimed invention without undue experimentation.

22. I understand that a patent claim is unpatentable if, at the time of the invention, it would have been obvious to one of ordinary skill in the art to combine the teachings of the prior art to yield the patent claim. It is my understanding that this determination is made after weighing the following factors: (1) the level of ordinary skill in the pertinent art; (2) the scope and content of the prior art; (3) the differences between the prior art as a whole and the claim at issue; and (4) as appropriate, other objective considerations identified below.

23. It is my understanding that the prior art and claimed invention should be viewed through the knowledge and understanding of a person of ordinary skill in the art – one should not use his or her own insight or hindsight in deciding whether a claim is obvious. I further understand that a claim may be rendered obvious if a person of ordinary skill in the art can implement the claimed invention as a

predictable variation of a known product. I further understand that a person of ordinary skill in the art is presumed to have knowledge of the relevant prior art at the time of the claimed invention, which comprises any prior art that was reasonably pertinent to the particular problems the inventor faced.

24. I understand that a showing of obviousness requires some articulated reasoning with a rational underpinning to support the combination of the references. I understand that in consideration of the issue of obviousness it is important to identify whether a reason existed at the time of the invention that would have led a person of ordinary skill in the pertinent art to combine elements of the references in a way that yields the claimed invention.

25. I understand that a claim may be considered unpatentable for obviousness for various reasons. I have been informed that the following exemplary rationales may support a finding of obviousness:

- (A) combining prior art elements according to known methods to yield predictable results;
- (B) substituting one known element for another to obtain predictable results;
- (C) use of a known technique to improve similar devices in the same way;
- (D) applying a known technique to a known device ready for improvement to yield predictable results;

- (E) choosing from a finite number of identified, predictable solutions with a reasonable expectation of success;
- (F) known work in a field that prompts variations in the work in the same or a different field that leads to predictable results; and
- (G) some teaching, suggestion, or motivation in the prior art that would have led a person of ordinary skill in the art to modify a prior art reference or combine multiple prior art references or teachings to arrive at the claimed invention.

26. I understand that various objective or “real world” factors may be indicative of non-obviousness. I understand that such factors include:

- (A) the commercial success of the claimed invention;
- (B) the existence of a long-felt, unresolved need for a solution to the problem solved by the claimed invention;
- (C) failed attempts to solve the problem solved by the claimed invention;
- (D) copying of the claimed invention;
- (E) unexpected results of the claimed invention;
- (F) praise for the claimed invention by others in the relevant field; and
- (G) willingness of others to accept a license under the patent because of the merits of the claimed invention.

27. It is my understanding that the prior art references themselves may provide a suggestion, motivation, or reason to combine, but other times the link may be based on the common sense of the person of ordinary skill in the pertinent art. I further understand that obviousness analysis recognizes that market demand, rather than scientific literature, often drives innovation, and market demand is sufficient motivation to combine references.

28. It is my understanding that a particular combination may be proven obvious merely by showing that it was obvious to try the combination. For example, common sense is a good reason for a person of ordinary skill to pursue known options when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions.

29. I further understand that a proper obviousness analysis focuses on what was known or obvious to a person of ordinary skill in the art, not just the patentee. Accordingly, it is my understanding that any need or problem known in the field at the time of invention and addressed by the patent can provide a reason for combining the limitations in the manner claimed.

5. The Relevant Art And Level Of Ordinary Skill In The Relevant Art

30. I understand that obviousness is determined from the vantage point of a person of ordinary skill in the relevant art at the time of the alleged invention (“POSITA”). The ’866 patent is directed to a wideband receiver system 200

“capable of receiving multiple desired television channels that extend over multiple non-contiguous portions of the broad frequency spectrum.” Ex. 1001, 1:29-34. I understand that a person of ordinary skill in the art is one who is presumed to be aware of all pertinent art, thinks along conventional wisdom in the art, and is a person of ordinary creativity.

31. I believe that a person of ordinary skill in the art of the '866 patent, at the time of the alleged invention of the '866 patent, would have 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. I worked in the relevant field with such persons at, and leading up to, the time of the alleged invention of the '866 patent, and thus, I am familiar with the knowledge that such persons had at the time (*i.e.*, early 2009 or early 2010). At that time, I had a skill level that was at least as high as the skill level I describe above for a person of ordinary skill in the art of the '866 patent.

32. All of my statements in this declaration regarding what a person of ordinary skill in the art would have known, understood, appreciated, been motivated to do, etc., refer to a person of ordinary skill in the art in early 2009 to early 2010,

before the earliest claimed priority date of the '866 patent (which, as I discuss below, is April 17, 2009).

6. Claim Construction

33. I understand that my analysis requires an understanding of the scope of the claims of the '866 patent. I understand that claim terms subject to *inter partes* review, absent some other definition provided in the patent, are given their ordinary meaning to a person of ordinary skill in the art in light of the patent specification. Therefore, in my analyses given below, I have assumed that all claim terms are given their ordinary interpretation as would have been understood by a POSITA reading the patent specification as of the priority date. I further understand that certain claim terms may be means plus function limitations. In particular, I understand that a “means plus function” limitation should be interpreted to cover only the corresponding structure described in the specification as performing the recited function, and equivalents thereof. I also understand that a limitation will be presumed to be a means plus function limitation if (a) the claim limitation uses the phrase “means for”; (b) the “means for” is modified by functional language; and (c) the phrase “means for” is not modified by sufficient structure for achieving the specified function. I understand that a structure will be considered structurally equivalent to the corresponding structure identified in the specification only if the differences between them are insubstantial. For example, a structure may be deemed

to be a structural equivalent to the corresponding structure where the structure performs the same function in substantially the same way to achieve substantially the same result.

34. I understand that all claim terms herein should be given their ordinary and customary meaning to a POSITA, consistent with the prosecution history, as they would be given in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b). It is my understanding that Petitioner does not contend that the claims include any means-plus-function limitations.

1. “Wideband”

35. The claims use the term “wideband.” The ’866 patent implicitly defines “wideband” as a band that carries multiple channels. For example, the ’866 patent states that a receiver is “wideband” if it is “designed to concurrently receive several TV channels.” Ex. 1001, 1:26-39. In my opinion, this is consistent with the ordinary and customary meaning of “wideband.”

2. “Digital Down Converter”/“Digital Front End”

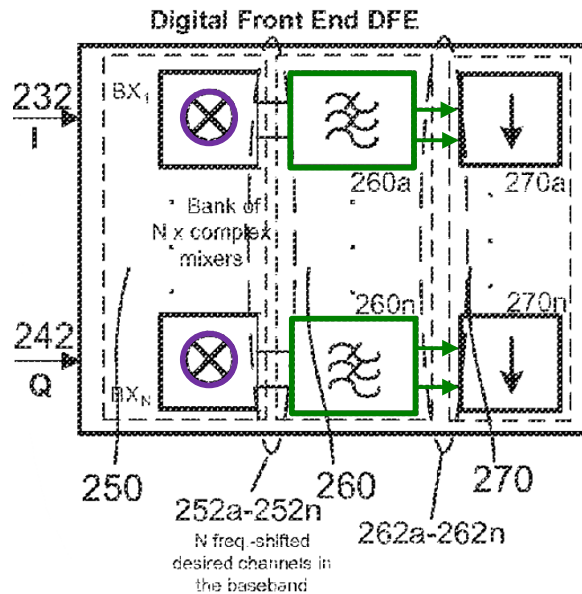
36. Independent claims 14, 41, and 69 recite a “plurality of digital down converters” that are “operable to generate a digital channel output corresponding to each desired channel.” A POSITA would have understood that the plain and ordinary meaning of digital down converter, as the term states, is digital circuitry that downconverts a digital signal. The ’866 patent specification and figures omit

the term “digital down converter” (or “down converter”), but describe a “Digital Front End (DFE)” that downconverts digital signals and with components operable to perform the functions and comprise the elements attributed to “digital down converters” in the claims. Ex. 1001, Figs. 2-3, 5:51-7:9, 9:50-60. Independent claims 1, 27 and 25 use the term DFE that, similar to the digital downconverters of claims 14, 41, and 69, is “configured to concurrently select and provide each of the plurality of desired channels,” but also requires “without providing any of the plurality of undesired channels.”

37. The example DFE from Figure 2 (below) includes a plurality of signal paths, with each path including a complex mixer 250 (purple), a low pass filter 260 (green), and optionally a demodulator with a serial or parallel interface to the demodulator.¹ Ex. 1001, Figs. 2-3, 5:51-7:9, 9:50-60. Each of these signal paths performs the function that claims 14, 41, and 69 ascribe to a digital down converter—generating a digital channel output corresponding to a desired channel. Ex. 1001, 5:51-7:9, 9:50-60, Figs. 2-3. That this structure is the digital down converter in the ’866 patent is consistent with the dependent claims, which require

¹ The ’866 patent alternatively refers to the boxes following the filters in Figures 2 and 3 as decimators and/or demodulators, and also discloses the DFE as having outputs to a demodulator. Ex. 1001, Figs. 2-3, 6:8-14, 7:4-9, 9:50-60.

the digital down converter(s) to have a digital mixer, filter, demodulator, and a serial or parallel interface. Ex. 1001, claims 16, 18-21, 40, 43-50, 68, and 71-76. The complex mixer in each path further performs “down-converting,” which the ’866 patent describes as shifting of the frequency of a signal to a lower frequency (also termed “down shift” and “frequency shift). Ex. 1001, 1:38-40, 2:2-6, 2:13-28, 2:59-63, 2:65-3:2, 4:60-66, 6:3-6, 6:7-56, 7:47-55, 9:18-26.



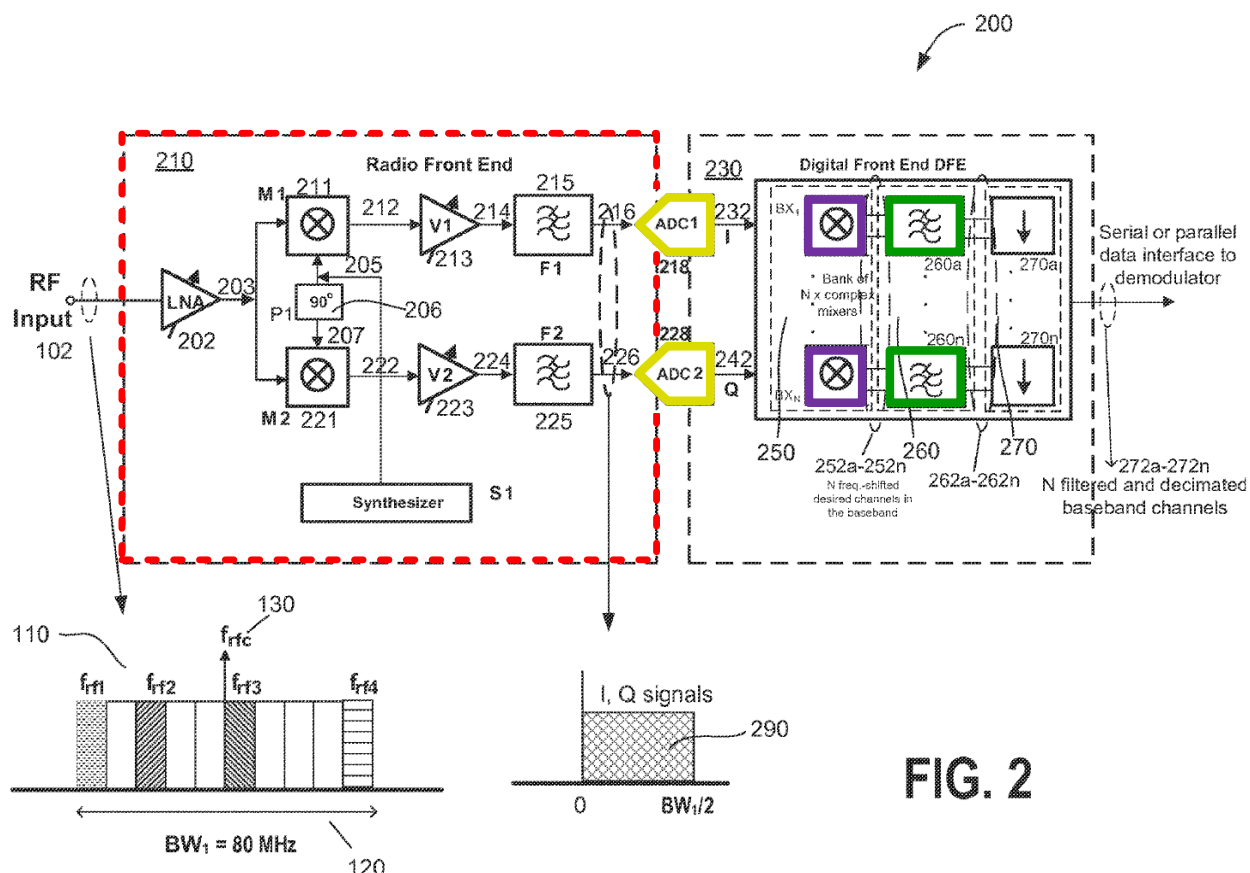
Ex. 1001, Fig. 2 (annotated and excerpted)

38. I do not believe that “digital down converter” and “digital front end” are means-plus-function terms. To the extent that either term is so construed to be a means-plus-function term, the corresponding structure for “digital down converter” includes the components in one signal path in the DFE, i.e., a complex mixer 250 and a filter 260, and the corresponding structure for a “digital front end” include

more than one such signal path. Ex. 1001, Figs. 2-3, 5:51-7:9, 9:50-60.

7. OVERVIEW OF THE '866 PATENT

39. The '866 patent describes a wideband receiver system 200 illustrated below that is “capable of receiving multiple radio frequency channels located in a broad radio frequency spectrum.” Ex. 1001, 1:26-29, 4:35-37. According to the '866 patent, a receiver is “wideband” if it is “designed to concurrently receive several TV channels.” *Id.*, 1:35-38.



Ex. 1001, Fig. 2 (annotated)

40. The system 200 receives desired and undesired television channels as frequencies dispersed within a frequency bandwidth BW_1 . Ex. 1001, 4:38-50. A

radio frontend 210 (**red**) downconverts the bandwidth of channels as in-phase and quadrature signals 212 and 222 at a low intermediate frequency (IF), which are then digitized by wideband analog-to-digital converters ADC1 and ADC2 (**gold**). Ex. 1001, 2:59-65, 4:61-5:7, 5:20-24, 5:48-51. U.S. Provisional App. No. 61/170,526 (“’526 provisional”), which the ’866 patent incorporates by reference, admits that the left side of Figure 2 (up to and including ADC1 and ADC2) “is similar to conventional tuners.” Ex. 1007 at 5; Ex. 1001, 1:6-22.

41. The digital I and Q signals 232 and 242 from ADC1 and ADC2 are input to a bank of N complex mixers 250 (each annotated above in **purple**) in a digital front end 230. Ex. 1001, 5:51-55. “Each of the N complex mixers ... extract[s] a different one of the desired channels” from the I and Q signals and “frequency-shifts the extracted signals to the baseband frequency.” Ex. 1001, 6:2-6. Filters 260a-260n (each annotated above in **green**) filter each frequency-shifted desired channel. Ex. 1001, 6:6-8. After (optional) decimation, baseband channels from multiple rows of digital front end 230 “will be sent as a serial or parallel digital data stream to a demodulator using a serial or parallel data interface according to commonly known methods.” Ex. 1001, 7:10-14.

7.1. Prosecution History

42. It is my understanding that U.S. Application No. 17/587,415, which became the ’866 patent, was filed on January 28, 2022, with a preliminary

amendment cancelling claims 1-18 and adding new claims 19-48 claims. Ex. 1004 at 2-109. On April 18, 2022, an Office Action rejected claims 19-48 for non-statutory double patenting over claims 1-27 of U.S. Patent No. 9,100,622, and rejected claims 19-27, 29-30, 33-42, 44-45, and 48 as obvious over U.S. Patent No. 6,760,342 (Skones et al.) in view of International Publication No. WO 02/087230 (Uskali et al.). Ex. 1004 at 119-131. The Office action indicated that dependent claims 28 and 43 (which recited a DFE/digital down converters operable to provide channels/outputs “via a serial interface”), claims 31 and 46 (which recited a “DVR”), and claims 32 and 47 (which recited “a picture-in-picture display”) contained allowable subject matter. Ex. 1004 at 131.

43. On April 18, 2022, Applicant filed a terminal disclaimer and an amendment that added the limitations of claim 28 to claim 19 (which issued as claim 1), added the limitations of claim 43 to claim 34 (which issued as claim 14), added new independent claim 49 (which issued as claim 27) based on original claims 19 and 31, added new independent claim 63 (which issued as claim 41) based on original claims 34 and 46, added new independent claim 77 (which issued as claim 55) based on original claims 19 and 32, and added new independent claim 91 (which issued as claim 69) based on original claims 34 and 47. Ex. 1004 at 148-164, 170-171. The amendment also added multiple sets of new dependent claims that paralleled existing dependent claims. Ex. 1004 at 148-164, 170-171. In response, the

U.S. Patent and Trademark Office issued a Notice of Allowance on May 25, 2022. Ex. 1004 at 188-195. The '866 patent issued on July 5, 2022. Ex. 1001, cover.

44. The prior art relied upon in this petition—Zhang, Reisman, Jackson, or Pandey—was not considered during prosecution of the '415 application.

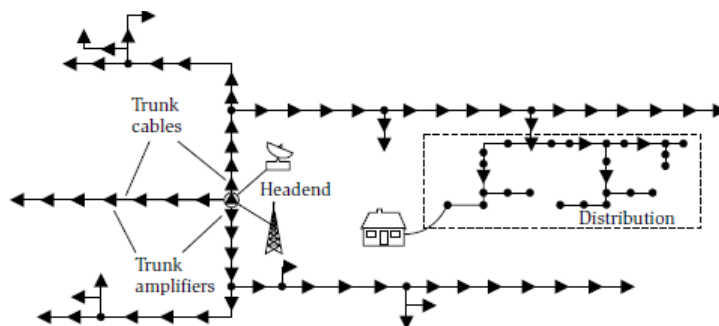
7.2. Earliest Priority Date for the Claims

45. The earliest possible effective filing date for the '866 patent claims is April 17, 2009, the filing date of the '526 provisional. I understand that each of the references relied on herein is prior art to that date.

8. OVERVIEW OF THE PRIOR ART

8.1. Cable and Satellite Television Networks

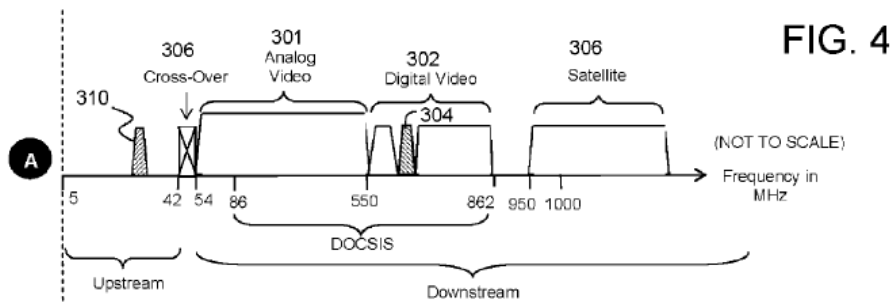
46. The origins of the cable and satellite television networks long predate the earliest claimed priority date (April 17, 2009) of the '866 patent. Cable television networks are entertainment distribution systems that allow consumers to access and enjoy various television channels. Ex. 1033 at 22. The cable television networks include one or more headends that are designed to broadcast and distribute, via coaxial cables, the data for the television channels as modulated radio frequency (RF) signals to multiple terminal equipment belonging to the consumers (e.g., television receivers, set-top boxes, data modems, digital video recorders, personal video recorders, and other terminal equipment). *Id.* at 22, 29-30, 40, 352; Ex. 1034 at 20-21. This is illustrated in Figure 1.1 of Ex. 1033.



Ex. 1033, Fig. 1.1 (Excerpted) (Page 34)

47. RF is the frequency range starting from 10kHz to 100,000MHz in the electromagnetic spectrum; signals having frequencies from this RF range are used for data transmission (wired or wireless) between devices. *See* Ex. 1015 at 7. The transmissions between the headends and the terminal equipment are governed by various well-known industry standards, including Data Over Cable Systems Interface Specification (DOCSIS). Ex. 1021 at 2-5, Fig. 1-2; Ex. 1033 at 27, 211-212.

48. Consumers can also access television channels from satellites via conventional home satellite television systems. Ex. 1035, 1:30-31; Ex. 1036, [0006]. Such home satellite television systems typically include a fixed dish antenna that receives television channels in modulated RF signals, as well as a satellite receiver or set-top box designed to process and demodulate the modulated RF signals. Ex. 1035, 1:31-35; Ex. 1036, [0013]. Satellites may also be used to distribute the television channels to headends of cable television networks, which are then redistributed to the consumers. Ex. 1033 at 262, 280-282; Ex. 1036, [0009].



Ex. 1037, Fig. 4 (Excerpted)

49. Figure 4 of Exhibit 1037 (partially reproduced above) illustrates the RF spectrum usage of television channels from cable and satellite television networks. Ex. 1037, [0079]-[0080]. In North America, television channels from cable television networks occupy the RF spectrum from 54 to 864 MHz, with digital channels occupying the RF spectrum above 550 MHz. Ex. 1033 at 413, 503; Ex. 1037, [0079]-[0080]. In 1941, the National Television System Committee, established by the United States Federal Communications Commission, set a standard that each television channel should be allocated 6 MHz of RF bandwidth and that the set of allocated television channels should occupy the RF spectrum in a contiguous manner. Ex. 1021 at 1, 23-24; Ex. 1033 at 45, 413, 515-520.

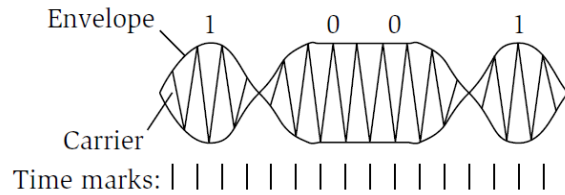
50. Television channels from satellite networks occupy various bands in frequencies greater than 950 MHz. Ex. 1035, 1:37-48; Ex. 1037, [0079]-[0080]. Signals in satellite bands are sent to a satellite receiver or set-top box, with the satellite bands carrying multiple transponder channels and each transponder channel carrying a number of different television channels. Ex. 1035, 1:37-48.

8.2. Modulated RF Signals

51. Modulation is a method where an RF carrier signal is varied (e.g., in amplitude, frequency, and/or phase) with information to be transmitted. Ex. 1033 at 155. The information to be transmitted can be digital data comprising of bits “1” and “0,” such as the digital data of television channels for transmission from headends of cable television networks or subscriber locations. *Id.* One of the main goals of modulation is to squeeze as much data into the allocated RF bandwidth as possible, and that objective, known as spectral efficiency, measures how quickly data can be transmitted in an assigned RF bandwidth. *Id.* at 156. The unit of measurement of spectral efficiency is bits per second per Hz (b/s/Hz). *Id.* As I discuss below, by the earliest claimed priority date of the ’866 patent, multiple modulation techniques facilitating high spectral efficiencies were known to a POSITA.

8.2.1. Biphase Shift Keying

52. Biphase shift keying (BPSK) is a simple form of modulation that can be used in digital cable and satellite television networks, where the phase of an RF signal is shifted 180° in phase between transmission of bit “0” and bit “1.” Ex. 1033 at 160-161, Fig. 4.3 (partially reproduced above). The spectral efficiency of BPSK modulation is 1 bit/s/Hz. *Id.* at 156.

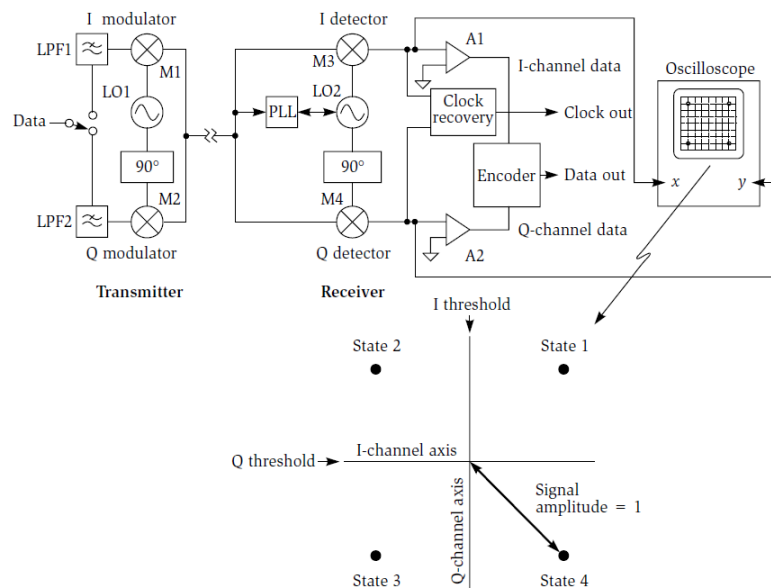


Ex. 1033, Fig. 4.3 (Excerpted) (page 161)

8.2.2. Quadrature Phase Shift Keying (QPSK)

53. In Quadrature Phase Shift Keying (also called 4-Quadrature Amplitude Modulation (4-QAM)), digital data is split into two components, an I (in-phase) component and a Q (quadrature) component. Ex. 1033 at 163-164, Fig. 4.4 (reproduced below). The same RF carrier signal is used for each component, but the phases of the two signals in the two components are 90° apart or in quadrature. *Id.* Signals in quadrature are orthogonal and do not interfere with one another. *Id.* Quadrature modulation takes advantage of this principal by combining two signals in quadrature for a combined output signal. *Id.* In quadrature modulation, digital data are broken into a discrete number of symbols, which are used to convey information. *Id.* at 164-165. These symbols are mapped to a discrete set of magnitude and phase values on an I/Q constellation, which are referred to as constellation points. *Id.* For example, in BPSK, each symbol can only represent a bit “0” or a bit “1” because the constellation of BPSK modulation has just two possible constellation points representing two possible states, or symbols, where each symbol represents a single bit of information. The constellation of QPSK modulation has four constellation

points representing four different states, or symbols: state 1 (bits “00”), state 2 (bits “01”), state 3 (bits “11”), and state 4 (bits “11”). *Id.* QPSK can, therefore, transmit 2 bits per symbol. *Id.* The RF carrier signals in each of the I and Q components are encoded with one of the two bits of the symbol. *Id.* at 163. Therefore, QPSK can transmit twice as much data using the same amount of bandwidth as BPSK, or it could transmit the same amount of data using half the bandwidth. *Id.* at 156.



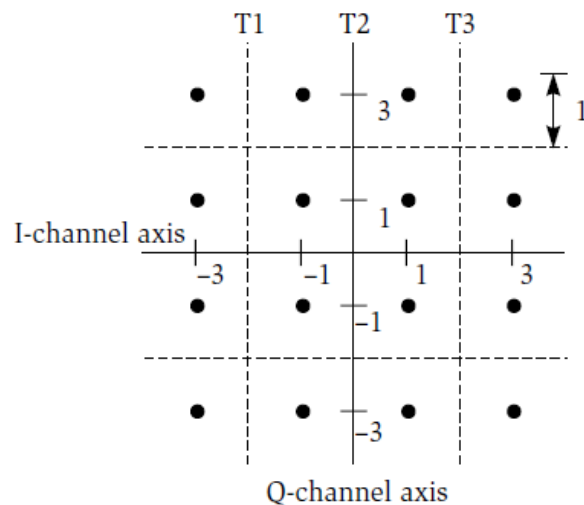
Ex. 1033, Fig. 4.4 (page 164)

54. After the two RF carrier signals from the two components I and Q are modulated, the RF carrier signals are combined for transmission to the receiver. Ex. 1033 at 163. At the receiver, the received combined signal is split back into the I-component and the Q-component by two mixers, M3 and M4. *Id.* at 163-164. The separation back into I/Q components allows the encoder inside the receiver to map

the two components onto the QPSK I/Q constellation and interpret which of the four possible symbols are encoded in the components. *Id.* at 164.

55. A POSITA would have been well aware that satellite television networks primarily used QPSK modulation. Ex. 1033 at 280; Ex. 1036, [0071], [0075]. Satellite transponders that transmit RF signals to headends and dish antennas are simply a frequency translator and a power amplifier, and for the sake of efficiency, it was preferred to use modulation formats that do not depend on amplitude changes to communicate information. Ex. 1033 at 280. QPSK modulation met this requirement of satellite transponders. *Id.*

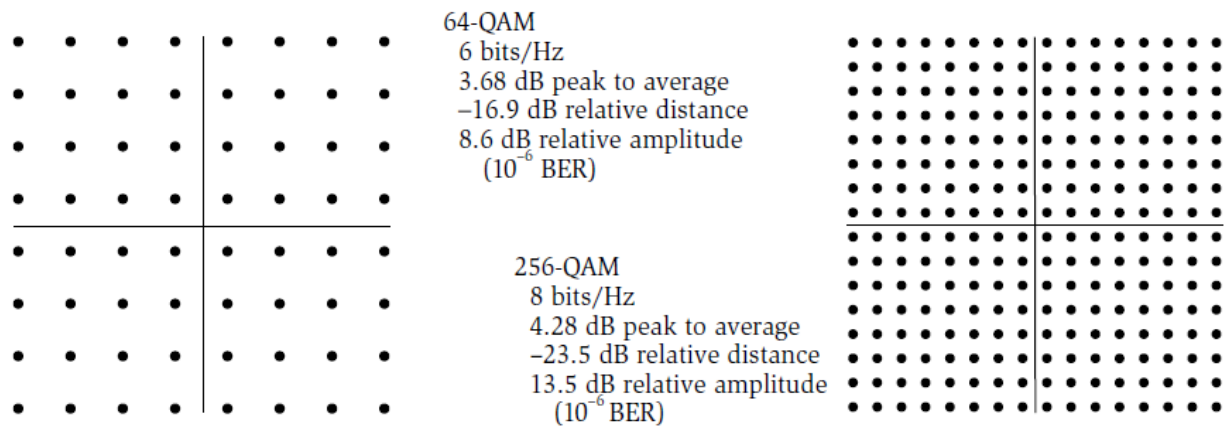
8.2.3. 16-Quadrature Amplitude Modulation (QAM), 64-QAM, and 256-QAM



Ex. 1033, Fig. 4.5 (Partial Excerpt) (page 167)

56. Modulation schemes with greater numbers of constellation points are able to transmit more information per symbol. Ex. 1033 at 166-169. The next denser

known modulation format after QPSK was 16-QAM, where data is split into I and Q components and carried by two RF signals in quadrature. *Id.* at 166. However, the 16-QAM I/Q constellation has sixteen different states (as illustrated by the sixteen dots in Figure 4.5 of Ex. 1033, partially reproduced above), where each state is a symbol that contains one of 16 different combinations of amplitude and phase levels. *Id.* Each symbol contains up to 4 bits and, therefore, can represent values from “0000” to “1111.” *Id.* at 166-167. The spectral efficiency of 16-QAM is 4 bit/s/Hz. *Id.* at 168, Fig. 4.6.



Ex. 1033, Fig. 4.6 (Partial Excerpt) (page 168)

57. Similarly, the I/Q constellation of 64-QAM (illustrated by Figure 4.6 of Ex. 1033, partially reproduced above) has sixty-four different states, where each state is a symbol that contains one of 64 different combinations of amplitude and phase levels. *Id.* Each symbol contains up to 6 bits (representing values from “000000” to “111111”), and the spectral efficiency of 64-QAM is 6 bit/s/Hz. *Id.* The

I/Q constellation of 256-QAM has 256 different states, where each state is a symbol that contains one of 256 different combinations of amplitude and phase levels. *Id.* Each symbol contains up to 8 bits (representing values from “00000000” to “11111111”), and the spectral efficiency of 256-QAM is 8 bit/s/Hz. *Id.*

58. DOCSIS (finalized in 1997), DOCSIS 1.1 (finalized in 2001), and DOCSIS 2.0 (finalized in 2002) mandate the use of either 64-QAM or 256-QAM for downstream data transmission from headends to consumers’ terminal equipment. Ex. 1033 at 168, 213-214. Therefore, a POSITA would have known that terminal equipment receiving signals from headends of cable television networks were required to demodulate signals that have been modulated using 64-QAM or 256-QAM. Moreover, a POSITA would have understood the relative benefits of using 64-QAM or 256-QAM versus BPSK, as 64-QAM and 256-QAM offer higher rates of spectral efficiencies than BPSK. *Id.* at 156.

8.3. Radio Receivers or Tuners for Cable and Satellite Television Networks

59. As discussed in Section 8.1, it was well-known to a POSITA that consumer terminal equipment (e.g., television receivers, cable set-top boxes, satellite set-top boxes, digital video recorders, personal video recorders, and other terminal equipment) receive modulated RF signals from headends and satellites. Ex. 1033 at 22, 29-30, 40, 352; Ex. 1035, 1:30-35; Ex. 1036, [0006]. A POSITA was also aware

that consumer terminal equipment included a radio receiver (also known as a tuner) that received the RF signals and processed them in such a way that a demodulator could demodulate the RF signals to recover the digital data encoded in the RF signals. Ex. 1033 at 408-411, Fig. 22.1; Ex. 1035, 1:35-37, 1:49-52; Ex. 1036, [0018], [0020]-[0021].

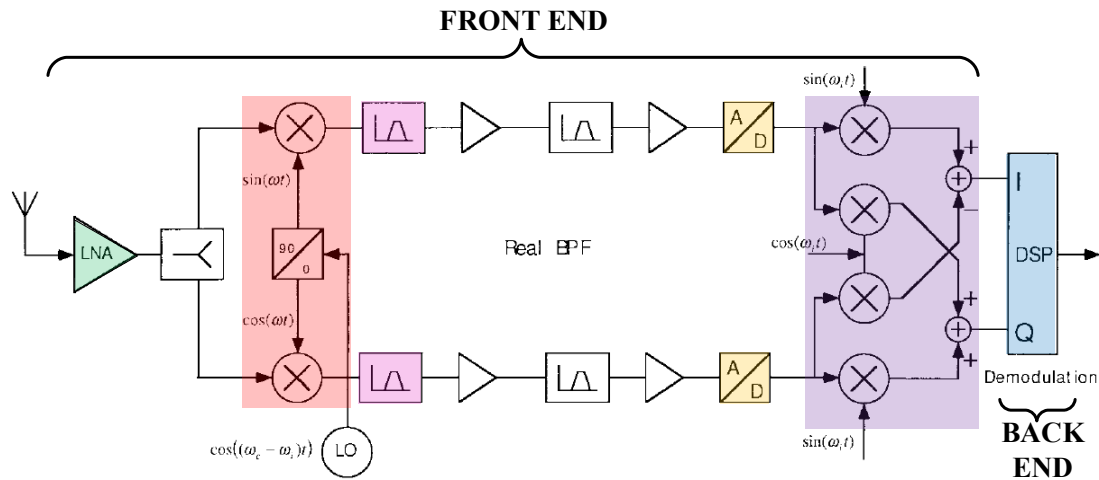
60. Cable television RF receivers concurrently receive RF signals for multiple digital television channels allocated in the RF frequency spectrum of 550 to 862 MHz. Ex. 1033 at 413, 503; Ex. 1037, [0079]-[0080], Fig. 4. Satellite RF receivers concurrently receive RF signals for multiple television channels allocated in the RF frequency spectrum above 950 MHz. Ex. 1035, 1:37-47; Ex. 1037, [0080]. Furthermore, the POSITA was aware that cable and satellite television radio receivers could tune (i.e., select and extract) signals for certain desired television channels (e.g., channels selected for viewing by a consumer) from the received RF frequency spectrum. Ex. 1033 at 299; Ex. 1036, [0020]-[0021]; Ex. 1042, 4:10-36; Ex. 1044, 1:51-58.

61. One type of receiver is known as an IF (intermediate frequency) receiver, and in particular, a type of receiver known as a low-IF receiver. By the earliest claimed priority date of the '866 patent, IF receivers, including low-IF receivers, were well-known in wireless communication systems for their high performance and low power consumption. Ex. 1025 at 270, 272; Ex. 1034 at 17, 65-

74. It was also known to a POSITA, by the earliest claimed priority date of the '866 patent, that low-IF receivers were conventionally used for receiving RF signals from cable television networks and satellite television networks. Ex. 1035, 1:49-61; Ex. 1038, [0022]-[0023], [0029]-[0030], [0042].

62. IF receivers have been used for a long time, and their way of operating is very well known. Ex. 1025 at 270. In general, IF receivers operate by initially downconverting RF signals, which may comprise multiple RF sub-bands each carrying one or more separate signals, from its RF carrier frequency to an intermediate frequency (IF). *Id.* The downconverted signals can be demodulated at the IF or further downconverted to baseband before being demodulated. *Id.* at 270, 279. When a band of signals is at baseband, the low end of the band is near zero frequency in the frequency spectrum or includes zero frequency. Ex. 1015 at 4. Intermediate frequency falls below the frequency of the RF signals but above the baseband frequency. Ex. 1034 at 22. Low-IF receivers initially downconvert to an IF that is at a relatively low frequency, such as a few hundred kilohertz. Ex. 1025 at 269.

8.3.1. Architecture of Low-IF receivers



Ex. 1025, Fig. 22(a) (Annotated)

63. Low-IF receivers (illustrated by Figure 22(a) of Ex. 1025, reproduced and annotated above) comprise two main portions: a front end that performs frequency downconversion of the RF signals, and a back end including a digital signal processor (DSP) that performs the actual demodulation of the RF signals. Ex. 1034 at 22-23. The demodulation technique that will be used in the DSP depends on the modulation technique used to modulate the incoming RF signals, and therefore, if the incoming RF signals are modulated using QPSK or QAM techniques (which modulate I and Q components), then demodulation is typically performed to extract the I and Q components of the incoming RF signals. *Id.* at 23. DSPs typically perform demodulation on baseband signals. *Id.*; Ex. 1039 at 11; Ex. 1025 at 269, 279. However, the received RF signals are at much higher (non-baseband)

frequencies. *Id.* Therefore, the front end must produce baseband quadrature I and Q components of the incoming RF signals to be usable by the DSP. Ex. 1034 at 23.

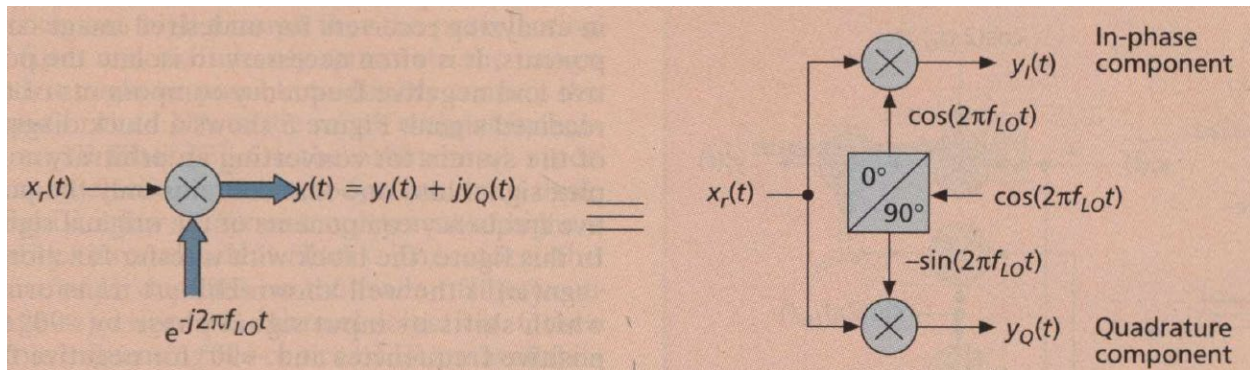
64. Still referring to Figure 22(a) of Ex. 1025 (reproduced and annotated above), in the front end of a low-IF receiver, the incoming RF signals are first amplified by a front-end low noise amplifier (LNA) (**green**) to provide enough gain to boost the received RF signal levels to an acceptable level such that further signal processing can be performed on the received RF signals; the LNA compensates for the attenuations of the RF signals during the transmission of the RF signals from another device. Ex. 1034 at 41; Ex. 1039 at 16. The RF signals are downconverted to baseband signals in two steps, where the first step (**red**) converts the RF signals to Intermediate Frequency (IF) signals before one or more analog-to-digital converters (ADCs) (**gold**) convert IF signals to digital signals, and the second step (**purple**) converts the digital signals of IF to baseband signals. Ex. 1025 at 270, 272; Ex. 1034 at 23.

65. In the first downconversion step, from RF to IF, the incoming RF signals are split and then down-converted by a quadrature downconverter (**red**), also referred to as a complex mixer or complex multiplier, which comprises two real mixers to produce I and Q components of the signals in IF. Ex. 1034 at 65-72; Ex. 1039 at 11 (“Two mixers are needed to retain both the amplitude and phase of the original modulated signal: one for the in-phase (I) and another for a quadrature (Q)

baseband output.”); Ex. 1018 at 133-134. For example, as explained in an article by Shahriar Mirabbasi and Ken Martin in IEEE Communications Magazine in November 2000:

The realization of a multiplier for mixing a real signal with a complex exponential requires two real multipliers, as illustrated in Fig. 2. *The real and imaginary parts of the mixer output are called the in-phase (I) and quadrature (Q) components of the downconverted signal (since cosine and sine are in quadrature).* In Fig. 2 the frequency of the complex exponential is chosen to be the same as the center frequency of the passband signal, for comparison with case 2 in Fig. 1. In this case there is no image problem associated with the *complex mixer*.

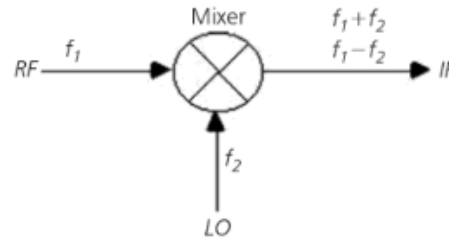
Ex. 1018 at 134 (emphasis added).



Ex. 1018, Fig. 2

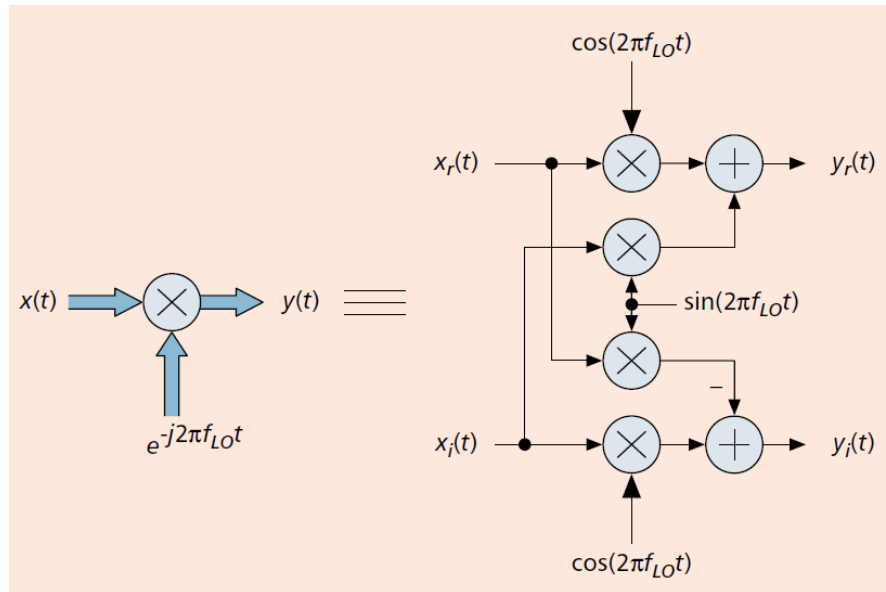
The term “mixer” and “multiplier” are often used interchangeably to refer to an analog or digital electrical circuit (represented by the symbol $\otimes$) that multiplies a

modulated input signal (e.g., an RF signal) at frequency f_1 and a reference signal (e.g., from a local oscillator LO) at frequency f_2 , which produces new signals at the sum and difference of the input frequencies, f_1+f_2 and f_1-f_2 . Ex. 1039 at 12-13. This is illustrated in Figure 8-9 from Ex. 1039.



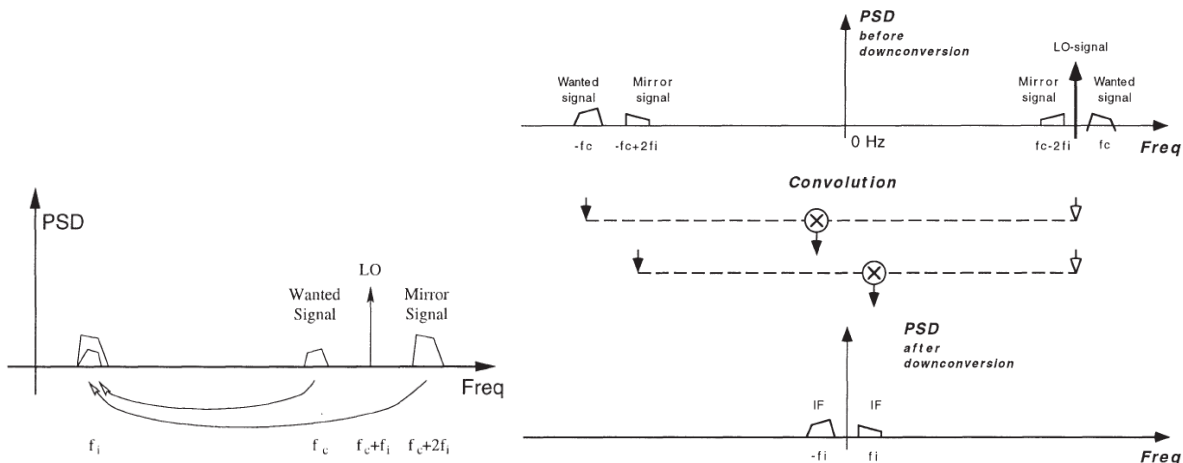
Ex. 1039, Fig. 8-9

By filtering out the signal with the sum (f_1+f_2), and passing only the signal with difference (f_1-f_2), the center frequency of the modulated input signal is reduced, or down-converted. A mixer/multiplier is “complex,” if it multiplies the input signal by a complex signal, having real and imaginary parts, to produce in-phase and quadrature signals. Ex. 1018 at 133. A complex mixer/multiplier can include two real mixers/multipliers when the input signal is real and the reference signal is complex as shown in Figure 22(a) of Ex. 1025 and Fig. 2 of Ex. 1018 above, or it can include four real mixers/multipliers if both the input signal and reference signal are complex as shown below. Ex. 1018 at 133-134, Fig. 3. As shown in the figure below, the symbol $\otimes$ is used interchangeably to refer to a complex mixer (left) or individual real multiplier/mixers (right) that make up a complex mixer.



Ex. 1018, Fig. 3

Referring back to Figure 22(a) of Ex. 1025, the RF signals could also be downconverted using a single mixer and a sinusoidal signal (as shown by Figure 2.6 of Ex. 1034, reproduced below); however, the main disadvantage of mixing an RF signal of frequency f_c with just a single sinusoidal signal $\cos(2\pi f_i t)$ to downconvert to intermediate frequency f_i is that a second mirror signal of frequency $f_c + 2f_i$ is also downconverted to frequency f_i . Ex. 1034 at 24.



Ex. 1034, Fig. 2.6 (page 26)**Ex. 1034, Fig. 3.23 (page 67)**

66. It was known that the mirror signal problem could be avoided by mixing the incoming RF signals with a complex signal, $\cos(2\pi f_i t) + j\sin(2\pi f_i t)$. Ex. 1034 at 28, 43; Ex. 1039 at 13. Mixing with such complex signals shifts a wanted RF signal at frequency f_c to frequency f_i while the unwanted mirror (or image) frequency signal at f_{c+2i} is shifted to frequency f_i . *Id.* Furthermore, separately mixing the RF signals with the signal $\sin(2\pi f_i t)$ produces the I-components of the RF signals, while mixing with $\cos(2\pi f_i t)$ produces the Q-components for the RF signals, and both of these components are needed for the DSP at the back end to ultimately demodulate the incoming RF signals. Ex. 1034 at 23. Filters (pink) can be used after the first stage of downconversion to filter out unwanted mirror signals. *Id.* at 28; Ex. 1039 at 17.

67. One could directly downconvert the incoming RF signal to baseband in the analog part of the RF receivers by using quadrature downconverters such that a second downconversion stage is not needed before the signals are forwarded to a demodulator; for example, zero-IF receivers perform such direct conversion. Ex. 1034 at 28; Ex. 1050 at 13-14. However, a significant problem in direct downconversion is the introduction of parasitic baseband signals at baseband, known as DC-offset, in the output of the quadrature downconverters. Ex. 1018 at 136; Ex. 1034 at 29; Ex. 1050 at 14-15. This DC-offset is mainly the result of the crosstalk

between the incoming RF signals and the complex signal of the quadrature downconverters, the self-mixing phenomenon of the local oscillator producing the complex signal, the leakage of the complex signals to the input of the LNA, and/or capacitive/inductive bonding between the different components of the RF receivers. Ex. 1018 at 136; Ex. 1034 at 29, 55-62; Ex. 1050 at 14-15. Such DC-offset issues are not present in low-IF receivers as the output of the first stage of mixing is at IF and not at baseband, and the downconversion at the second step is digitally performed. Ex. 1018 at 137-138; Ex. 1034 at 72. Furthermore, in the analog part of the RF receivers, mismatches between the two components of the complex signal and differences along the two branches of quadrature mixers and any following amplifiers and filters can cause the corruption of the I/Q components of the downconverted signals. Ex. 1018 at 138; Ex. 1034 at 29, 42, 55. However, such mismatches are not an issue in the second digital downconversion step. Ex. 1018 at 137-138; Ex. 1034 at 74, 76.

68. Analog-to-digital converters (ADCs) (**gold**) were commonly used in RF receivers for either IF or baseband signal sampling. Ex. 1039 at 18. Therefore, referring again to Figure 22(a) of Ex. 1025 (reproduced and annotated above), the quadrature downconverter (**red**) downconverts the incoming RF signals to produce I and Q components in IF before two ADCs separately digitize the IF I and Q components. Ex. 1034 at 42. The digitized I and Q components are further

downconverted to baseband by a digital complex mixer (**purple**) (comprising four digital mixers represented by the symbol $\otimes$ and two summers) before being forwarded to the DSP (**blue**).

8.3.2. Channel Selection based on Digital Filters

69. RF receivers receive RF signals for multiple television channels from cable and satellite television networks. Ex. 1035, 1:37-47. An important function for RF receivers is the ability to tune or filter out the signals for a desired television channel from the received RF signals such that only the signals of the desired television channels are demodulated. Ex. 1033 at 510. A POSITA would have known that digital filters based on digital signal processing are far superior to analog filters as digital filters do not suffer from manufacturing variations or aging, are easily programmable and tunable, have low power consumption, are unaffected by environmental influences, and have a superior performance-to-cost ratio. Ex. 1041 at 43. Digital filters, such as low pass filters and band pass filters, were known to select signals of desired television channels in RF receivers. Ex. 1035, 11:13-23, Fig. 7A; Ex. 1042, 6:5-8, Fig. 1B; Ex. 1043, 5:13-29, 5:46-53; Ex. 1050 at 44, 48.

- Low pass filter: A low-pass filter is a filter that passes signals with a frequency lower than a selected cutoff frequency (ω_c) and attenuates signals with frequencies higher than the cutoff frequency. Ex. 1041 at 14.

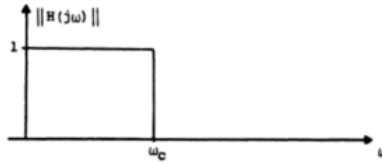


Fig. 1.23. Ideal LP filter magnitude frequency response.

Ex. 1041, Fig. 1.23

- Bandpass filter: A bandpass filter allows a specific range of frequencies (ω_1 to ω_2) to pass through while attenuating frequencies outside that range. Ex. 1041 at 21.



Fig. 1.27. Ideal BP filter.

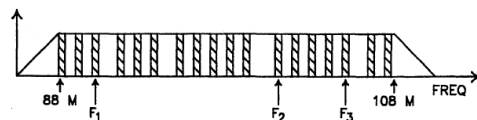
Ex. 1041, Fig. 1.27

A bandpass filter allows signals within a selected frequency range (e.g., signals for a selected television channel) to be isolated from undesired signals from outside the range. Ex. 1043, 5:12-15; Ex. 1050 at 44. Signals for a desired television channel can also be isolated from signals of undesired television channels by downconverting all the signals such that the signals for the desired television frequency are placed at baseband and then applying a low pass filter function to isolate the signals of the desired television channel. Ex. 1043, 5:46-50; Ex. 1050 at 48. However, low pass filters are preferred over bandpass filters as low pass filters

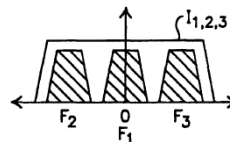
require fewer computational steps and, therefore, less computational power than bandpass filters. Ex. 1050 at 33, 48-49. It was also known to a POSITA that low pass filters and bandpass filters use well-known digital architectures of Finite Impulse Response (FIR) filters. Ex. 1041 at 24-63; Ex. 1043, 5:15-17; Ex. 1050 at 44.

70. Some receivers may allow signals of two or more desired channels to be filtered out such that consumers may enjoy a feature called picture-in-picture, where a small window showing one of the desired television channels is inserted into a larger window showing another one of the desired television channels. Ex. 1033 at 467; Ex. 1035, 4:37-43. For example, Khoini-Poorfard (Ex. 1035) describes using two RF receivers to filter and demodulate two television channels such that the filtered television channels can be used in the picture-in-picture feature. Ex. 1035, 4:37-43, 11:13-23, Fig. 7A.

8.3.3. Stacking of Desired Channels before Demodulation



Ex. 1044, Fig. 1



Ex. 1044, Fig. 6

71. Khoini-Poorfard (Ex. 1035) describes using two RF receivers that individually filter and demodulate two television channels. Ex. 1035, 4:37-43, 11:13-23, Fig. 7A. Kelly (Ex. 1044) describes an RF receiver that demodulates multiple desired channel bands without expensive hardware requirements and

hardware duplications. Ex. 1044, 2:42-50. The RF receiver in Kelly digitizes RF signals comprising multiple desired RF bands in an RF spectrum (e.g., bands F_1 , F_2 , and F_3 in Figure 1 of Ex. 1044 reproduced above) and subjects the digitized signals to multiple frequency translations such that the desired bands are adjacent to each other (e.g., bands F_1 , F_2 , and F_3 are adjacent to each other in Figure 6 of Ex. 1044 reproduced above). *Id.*, 2:51-58, 4:38-40, 4:54-5:9. The desired frequency bands are then digitally separated, demodulated and processed to provide multiple outputs from the single receiver. *Id.*, 2:58-60.

8.3.4. Decimation

72. ADCs in RF receivers convert incoming RF signals to digital signals by sampling the RF signals at a rate that is at least twice the highest frequency of the RF signals. Ex. 1045 at 70. The reason for the high sampling rate is to prevent information loss during digitization; the Nyquist theorem specifies that a sinusoidal function in time or distance can be regenerated with no loss of information as long as it is sampled at a frequency greater than or equal to twice per cycle. *Id.*; Ex. 1033 at 98-99. That is, if you digitize an analog signal by sampling the signal at two or more times the highest frequency contained in the signal, that signal can be theoretically converted back to the exact same analog signal by passing the signal through a low pass filter. The Nyquist theorem is a fundamental principle that enables us to digital signal process (DSP) analog signals (radio waves, sound waves,

vibrations, etc.) that exist in the real world. Ex. 1033 at 98-101. Because the sample rate of the resulting signal from an ADC may be too high for subsequent DSP processing, decimation is typically performed on the sampled signals at baseband to lower the sampling rate. Ex. 1034 at 104; Ex. 1045 at 70. Decimation is a well-known process that reduces the original sample rate of a signal to a lower rate. Ex. 1045 at 14-15. A decimation filter can be implemented in a digital signal processing block of an RF receiver after the second downconverting step. Ex. 1034 at 104; Ex. 1045, Fig. 3.57 (page 71); Ex. 1046, 2:51-57.

8.3.5. Demodulation of Multiple Channels

73. A POSITA would have been well aware that either a single demodulator or multiple demodulators can perform demodulation of signals for multiple selected television channels. Ex. 1019, 1:67-2:7, 2:32-35, 2:61-63, 3:50-52; Ex. 1044, 7:53-57. For example, Carson (Ex. 1019) describes a multichannel time-shared demodulator that demodulates the signals of multiple channels concurrently using time division multiple access (TDMA) techniques. Ex. 1019, 1:67-2:7, 2:32-35, 2:61-63, 3:50-52. Another example is shown in Azenkot (Ex. 1075), which describes a single shared demodulator for demodulating multiple time-division multiplexed QAM channels in a cable modem termination system (CMTS) in a hybrid fiber-cable (HFC) network. Ex. 1057, Abstract, 1:6-14, 6:14-22, 6:30-37; 7:15-20, 32:53-33:14. As another example, Shadwell (Ex. 1076) discloses the

system shown below, which receives multiple digitized downconverted channels (green), which are time-multiplexed together (purple) into a data stream (orange) that is output to a single demodulator (brown), which then provides a demodulated time-multiplexed output (light blue).

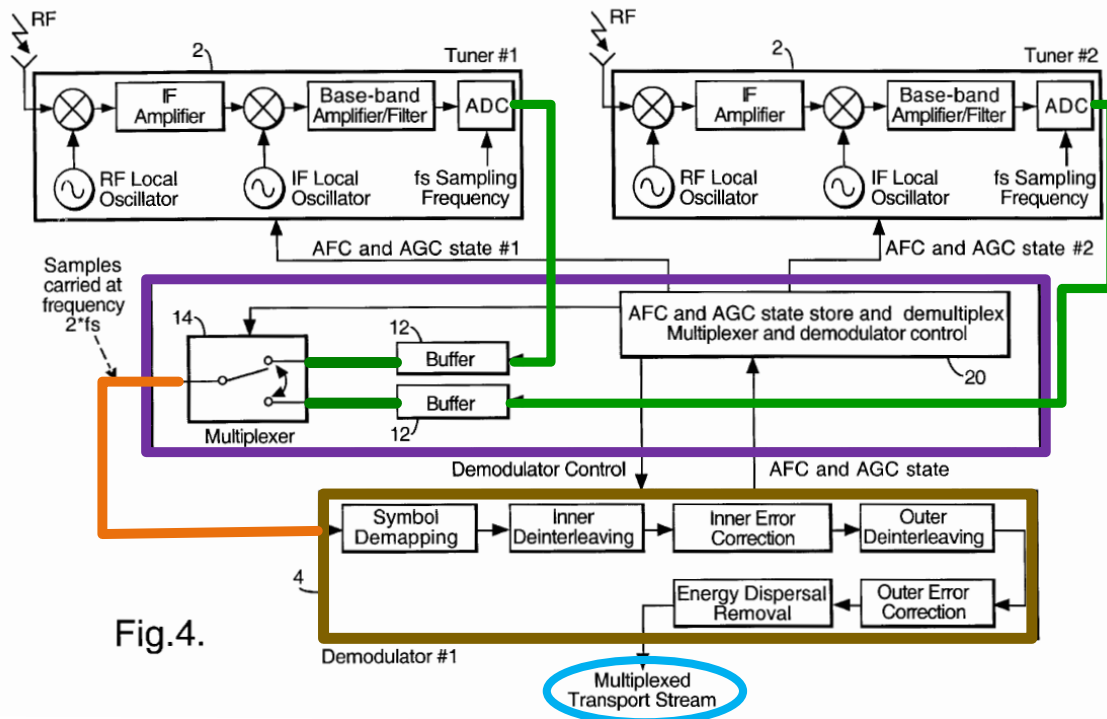


Fig.4.

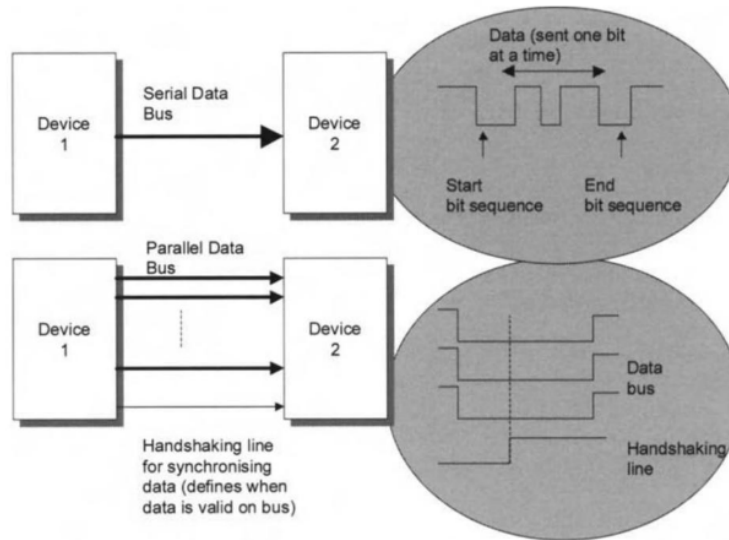
Ex. 1076, Fig. 4 (annotated).

A POSITA would have been well aware that single demodulator at the time, such as those disclosed in Carson, Azenkot, and Shadwell, or as disclosed in Zhang as further discussed below, were capable of demodulating multiple selected channels. Ex. 1076, Abstract, 2:28-52, 3:6-17, 4:21-32, 6:19-37, Figs. 1a, 1b, 2, 4. The use of a single demodulator would reduce cost of the system, and enable certain functionality, such as providing a transport stream including two demodulated

television channels, for example, for decoding a picture-in-picture stream. Ex. 1076, 2:13-26, 2:53-59.

8.4. Serial vs. Parallel Data Communication

74. As described throughout subsection 8.3 above, the different components of an IF receiver, including a low-IF receiver, were known to a POSITA prior to the '866 patent. It was also known to the POSITA by the earliest claimed priority date (April 17, 2009) of the '866 patent that the different components of low-IF receivers, such as the front end and the back end, could be fabricated on the same chipset or as different chipsets, and different types of buses could later connect the chipsets. Ex. 1034 at 23, 183; Ex. 1048 at 16. Data buses were known to pass data between electronic components. Ex. 1048 at 16. The data could be either passed in a serial manner by passing one bit at a time in a single bus, or in a parallel manner where several bits are transmitted simultaneously and each along its own separate channel. *Id.*; Ex. 1049, 1:10-28.



Ex. 1048, Fig. 2.3 (page 17)

75. A POSITA would have known that data transmission using parallel data buses offers a much higher data transmission rate than data transmission using a serial data bus. Ex. 1048 at 16. However, the parallel bus structure requires a larger number of conductors and more space on the chip. Ex. 1049, 1:32-40. Furthermore, due to natural aberrations in the structure of each bus (e.g., resistance), signals in parallel data buses do not arrive at the same time, creating a problem known as “skew.” *Id.*, 1:24-40. This problem becomes more severe as the distances between chipsets increase. *Id.*

76. Therefore, it was well known before the claimed priority date of the ’866 patent to use technologies such as those described above in subsections 8.2.2-8.2.3 to broadcast data for television channels using QPSK and QAM modulated RF signals, and to use radio frequency receivers and tuners, such as low-IF receivers, to

receive and process the RF signals to select one or more desired television channels. As also discussed above, such processing was well-known to include channel stacking, downconversion, channel selection (e.g., filtering), demodulation, and decimation, as well as parallel and serial bussing between receiver components.

8.5. U.S. Publication No. 2003/0056221 – Zhang (Ex. 1013)

77. Zhang (U.S. Pub. No. 2003/0056221, Ex. 1013) published on March 20, 2003. Ex. 1013, cover.

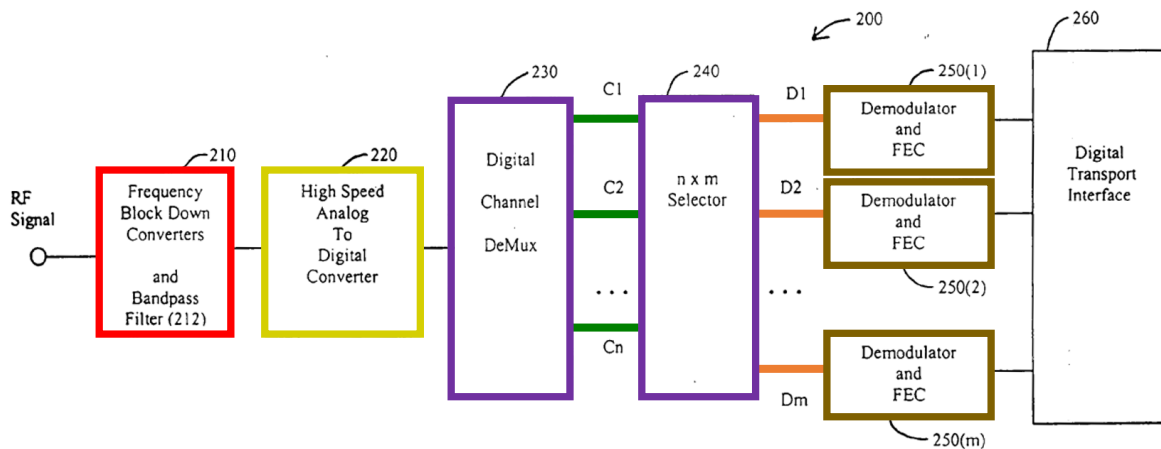


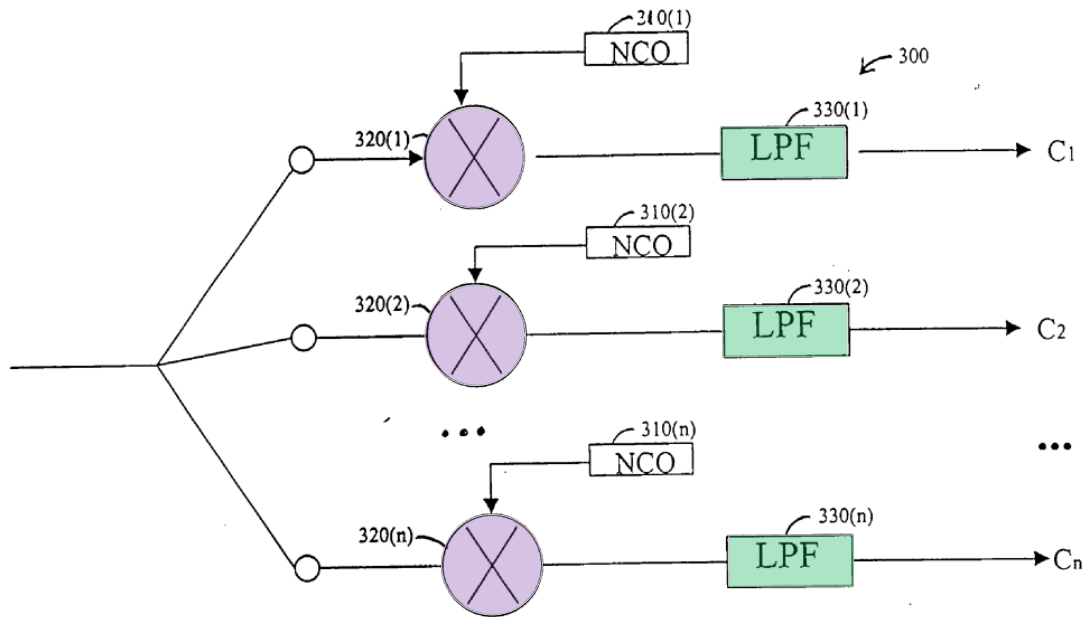
Fig. 2

Ex. 1013, Fig. 2 (annotated)

78. Zhang describes a multi-channel demodulator circuit 200 (illustrated by above) that can be used as “advanced wide-band front-ends for digital set-top boxes, PVRs, home gateways and home media centers.” Ex. 1013, [0044]-[0045], Fig. 8. The multi-channel demodulator circuit 200 receives a multi-channel Radio Frequency (RF) signal and demodulates channels within the RF signal that are selected by a subscriber. Ex. 1013, [0011], [0024], [0028]-[0029], [0038]-[0040],

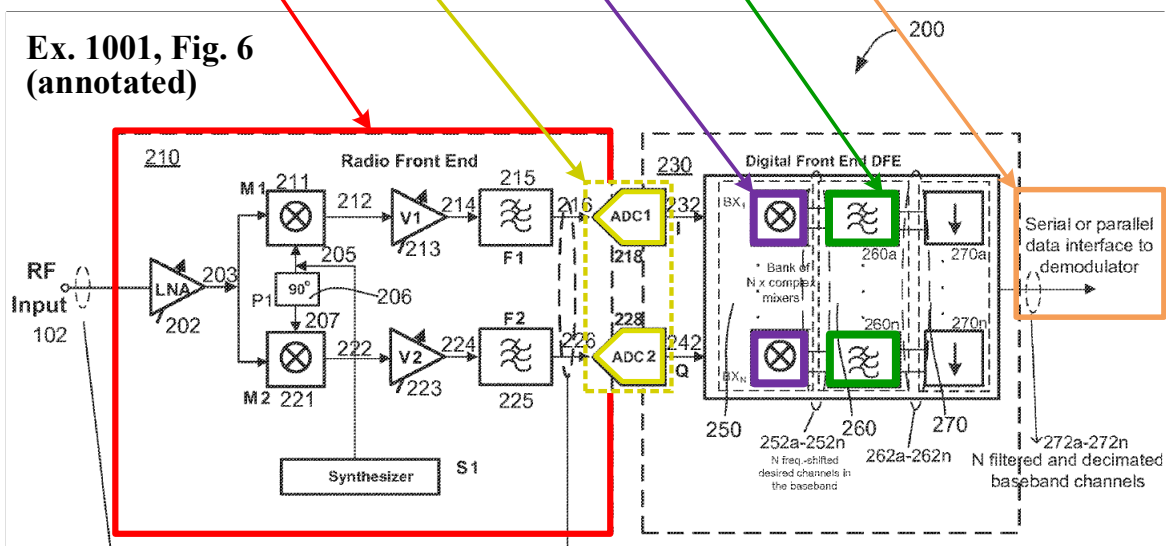
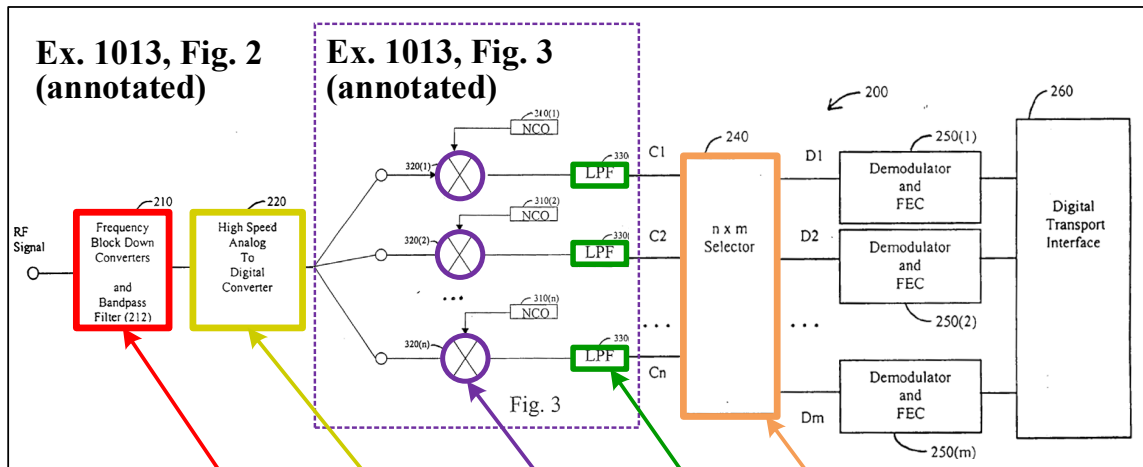
[0042]. The Zhang multi-channel demodulator circuit comprises a frequency block down-converter 210 (**red**) that receives the multi-channel analog RF signal and shifts the signal to a lower frequency such that an analog-to-digital converter 220 (**gold**) can convert the analog RF signal to a digital RF signal. Ex. 1013, [0010], [0023], [0025], [0027], [0030]-[0036], [0041]-[0042]. A digital channel demultiplexer 230 (**purple**) then separates channels (e.g., C_1 to C_n) within the digital RF signal, while an $n \times m$ digital selector 240 selects and forwards only a subset of the channels (e.g., D_1 to D_m) to one or more demodulators 250(1), 250(2), . . . 250(m) (**brown**). Ex. 1013, [0010]-[0011], [0028]-[0029], [0042], [0047], claims 1, 4, 9, 31-32. The demodulators 250(1), 250(2), . . . 250(m) receive and demodulate the selected channels to recover audio and video content. Ex. 1013, [0007].

79. As shown below, the digital channel demultiplexer 230 includes a bank of numeric control oscillators 310(1...n), complex multipliers 320(1... n) (**purple**), and low-pass filters (LPFs) 330(1 . . . n) (**green**). Ex. 1013, [0030]. Each complex multiplier 320 multiplies the digital RF signal with a different select frequency provided by a numeric control oscillators 310) to shift a target channel within the digital RF signal to be near baseband (0 Hz). Ex. 1013, [0032]. The low-pass filters (LPFs) 330(1 . . . n) then “filter[] undesired RF channels and pass[] only the target RF channel.” Ex. 1013, [0032], claim 37.



Ex. 1013, Fig. 3 (annotated)

As I show below and discuss in the following sections, Zhang discloses the same cable TV device as in the '866 patent. This includes a “wideband analog-to-digital converter (ADC)” for digitizing a contiguous band of frequencies with (gold) (Element [1B]), and a digital front end (DFE) for concurrently selecting a plurality of desired channels” (purple/green) (Element [1C]) and for providing a plurality of desired channels via a serial interface (orange) (Element [1C]).



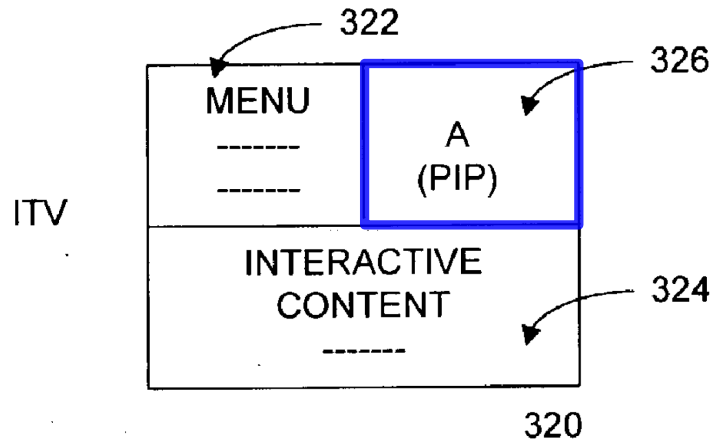
80. It is my opinion that Zhang is in the same field of endeavor as the '866 patent, and thus is analogous art. For example, and like the '866 patent, which “relates to wideband receiver systems and methods having a wideband receiver that is capable of receiving multiple radio frequency channels located in a broad radio frequency spectrum,” Zhang relates to a system and method for “receiv[ing] a multi-channel analog RF signal.” Ex. 1001, 1:26-29; Ex. 1013, [0010], Fig. 2. It is my opinion that Zhang is also reasonably pertinent to problems with which the '866

patent is concerned, and is also analogous art on that basis. For example, Zhang describes “support[ing] multiple simultaneous channels of digital content delivered over the cable system” by down-converting multi-channel analog RF signal to a multi-channel digital RF signal, conversion to baseband, and filtering in the same way as is described by the ’866 patent. Ex. 1001, 5:33-7:9, Figs. 2, 3; Ex. 1013, [0005], [0007], [0027], [0030], [0032], [0036], Figs. 2, 3.

8.6. U.S. Pub. No. 2003/0229900 – Reisman (Ex. 1052)

81. Reisman (U.S. Pub. No. 2003/0229900, Ex. 1052) published on December 11, 2003. Ex. 1052, cover.

82. Reisman is directed to advanced TV systems that coordinate the viewing of traditional audiovisual content with hypermedia and interactive features. Ex. 1052, Abstract, Fig. 3, [0120]-[0121], [0125]. Reisman discloses that such systems include a set-top box in a cable system, and that the set-top box has various features, such as a digital video recorder (DVR) and a “picture-in-picture display” output, e.g., as shown below (**blue**). Ex. 1052, Fig. 3 (326), [0005], [0043], [0048], [0060], [0073], [0098], [0112], [0118], [0120]-[0121], [0187], [0191], [0197], [0212], [0278], [0281]-[0285], [0291], [0296], [0378], [0534], [0537], [0546].



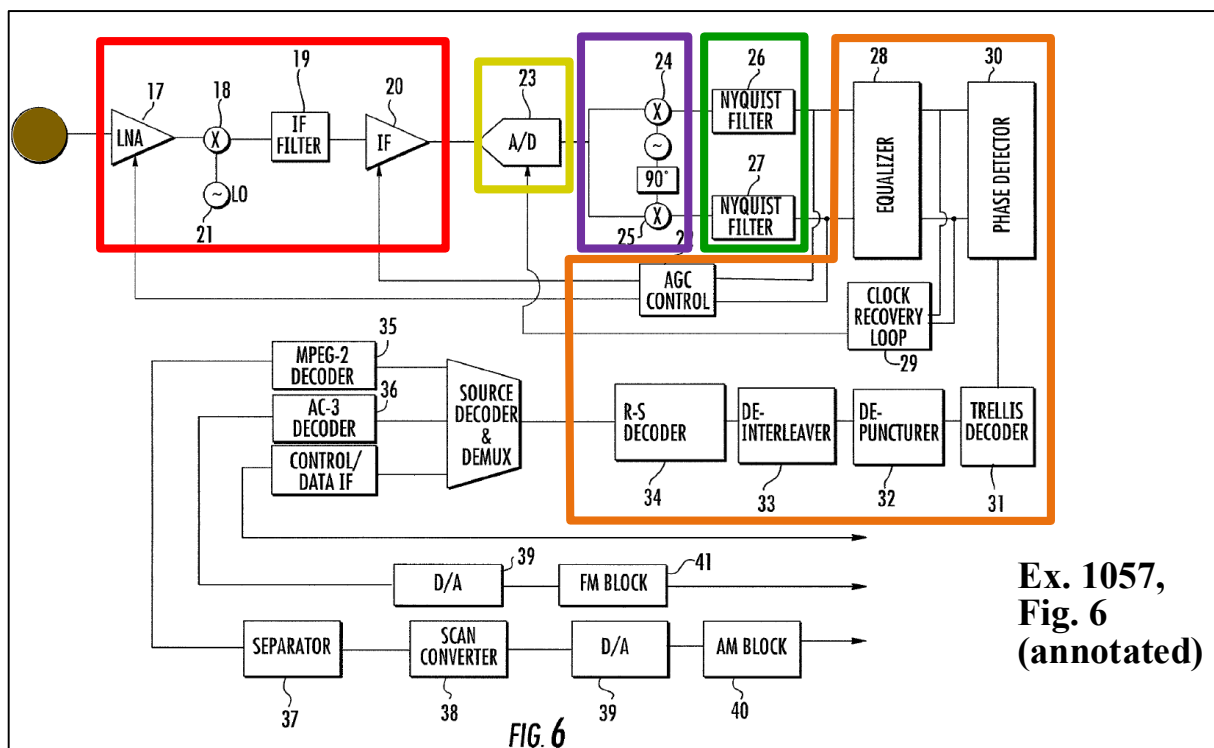
Ex. 1052, Fig. 3 (annotated)

83. It is my opinion that Reisman is in the same field of endeavor as the '866 patent, and thus is analogous art. For example, both Reisman and the '866 patent relate to advanced TV receiver systems. *See, e.g.,* Ex. 1001, Abstract, 1:26-34, 2:45-56, Figs. 2, 4, 6; Ex. 1052, Fig. 3 (326), [0073], [0099], [0100], [0248], [0306]. It is also my opinion that Reisman is also reasonably pertinent to problems with which the '866 patent is concerned, and is also analogous art on that basis. For example, Reisman describes the same enhancement feature related to television systems as described in the '866 patent—picture-in-picture (PIP), which is a region of a screen used to present a reduced scale video image, as shown above (**blue**). Ex. 1001, 1:48-52, Figs. 2, 3; Ex. 1052, Fig. 3 (326), [0005], [0043], [0048], [0060], [0073], [0098], [0112], [0118], [0120]-[0121], [0187], [0191], [0197], [0212], [0278], [0281]-[0285], [0291], [0296], [0378], [0534], [0537], [0546].

8.7. U.S. Pub. No. 2009/0113504 – Jackson (Ex. 1057)

84. Jackson (U.S. Pub. No. 2009/0113504, Ex. 1057) was filed on October 26, 2007.

85. Jackson discloses a receiver system (similar to the system in Zhang and '866 patent) for demodulating digitally encoded cable (TV) channels. Ex. 1057, [0001]-[0002], [0024]-[0025]. The receiver system includes a cable network connector (**brown**), an RF tuner front end (**red**) with analog amplifiers and filters, an analog-to-digital converter (**gold**), a complex mixer (**purple**) that outputs in-band (I) and quadrature components (Q), filters (**green**), and a demodulator/FEC decoder (**orange**). Ex. 1057, Figs. 4b, 5-6, [0023]-[0027], claims 1, 8, 12; Ex. 1013, Fig. 2, [0023], [0045].



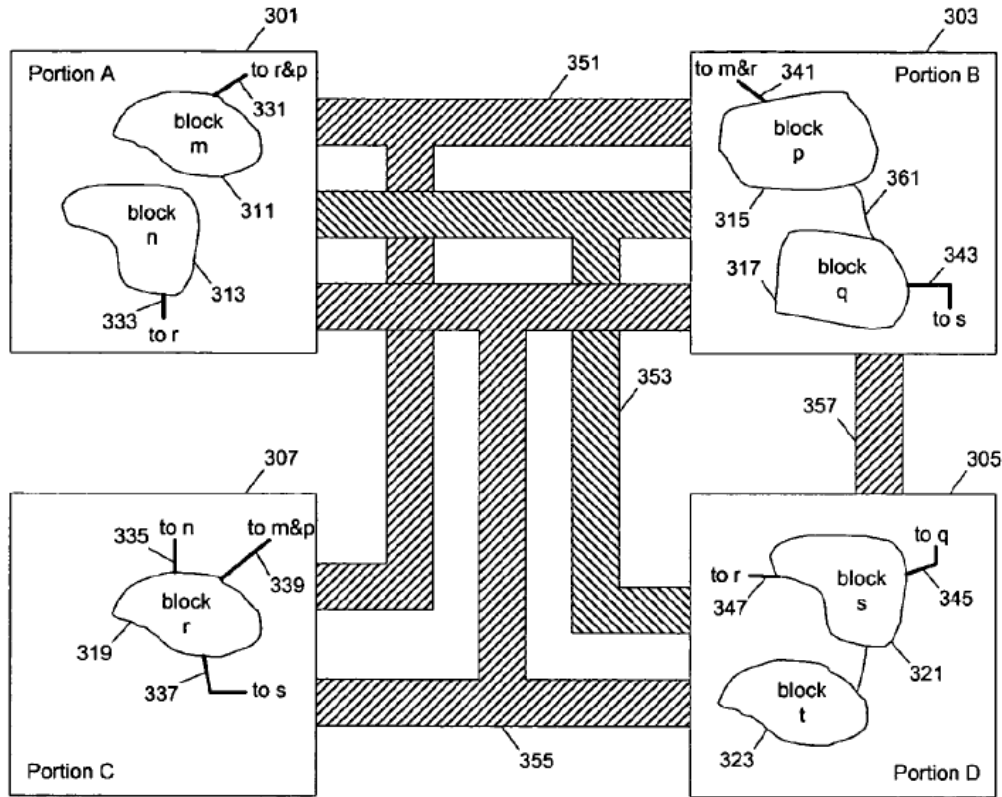
86. It is my opinion that Jackson is in the same field of endeavor as the '866 patent, and thus is analogous art. For example, and like the '866 patent, which relates to downconverting channels to an intermediate frequency and then demodulating those channels, Jackson relates to a television receiver system for demodulating digitally encoded cable (TV) channels, Ex. 1001, 1:35-45, 5:49-61; Ex. 1057, [0024]-[0025], claims 4, 11, Fig. 6. It is my opinion that Jackson is also reasonably pertinent to problems with which the '866 patent is concerned, and is also analogous art on that basis. For example, Jackson describes “allow[ing] a conventional analog television receiver to function in a fully digital CATV system” by down-converting an analog RF signal to an intermediate frequency digital RF signal and filtering in the same way as is described by the '866 patent. Ex. 1057, Abstract, [0024]-[0025], claims 4, 11, Figs. 5, 6.

8.8. U.S. Patent No. 7,237,214 – Pandey (Ex. 1014)

87. U.S. Patent No. 7,237,214 to Pandey (“Pandey”) indicates on its face that it was issued on June 26, 2007. Ex. 1014, cover.

88. Pandey teaches a computer aided design technique for digital circuits on a chip (e.g., field programmable gate arrays or application-specific integrated circuit). Ex. 1014, Abstract, 1:15-55, 2:4-12. The process partitions functional blocks to different regions of an integrated circuit chip (e.g., 301, 303, 305, 307 as illustrated below) and assigns wire traces (e.g., 351, 353, 355, 357) to interconnect

the partitioned blocks. Ex. 1014, 1:56-60, 2:6-12, 2:64-3:27, 6:10-15, 11:6-19, 13:33-14:7.



Ex. 1014, Fig. 3

89. Pandey further describes time-multiplexing a number of signals (nets) between function blocks over a single trace. Ex. 1014, 10:24-53, 10:58-11:5, 29:44-58, 30:31-42. Pandey's process optimizes the partitioning of blocks based on reducing the multiplexing ratio of wires to signals required between partitions. Ex. 1014, 5:50-53, 6:11-15, 6:44-53, 7:13-19, 29:44-30:9, 30:53-31:12, 32:12-15, Figs. 38-39. Thus, depending upon the partitioning of the circuit design within finite area and finite interconnection of a chip, Pandey's optimization will in some layouts

result in signals being grouped and time multiplexed through a serial interface between partitions, and in other layouts result in signals having individual dedicated traces with no multiplexing, which is a parallel interface. Ex. 1014, 31:20-22, 32:12-15.

90. It is my opinion that Pandey is reasonably pertinent to problems with which the '866 patent is concerned (as well as to problems with which Zhang is concerned), and is analogous art to the '866 patent (and to Zhang) on at least that basis. The '866 patent describes at length how signals may be processed in digital form. Ex. 1001, 5:33-6:8, Figs. 2-3. Zhang similarly includes such disclosure. Ex. 1013, [0025], [0027]-[0035], [0037]-[0039], [0042], Figs. 2-5. For example, the '866 patent indicates that signals recovered from received RF signals may be output to a demodulator using a serial or parallel data interface, but leaves the particulars to “commonly known methods.” Ex. 1001, 7:10-14, Fig. 2. It is my opinion that a POSITA would consider Pandey, which describes both serial and parallel interfaces for groups of signals between digital functional blocks, as a pertinent example of those “commonly known method.” Ex. 1014, 11:6-19, 13:33-55, 31:20-22, 32:12-15, Figs. 2-3. It is my opinion that a POSITA would similarly consider Pandey pertinent to Zhang, which describes digital circuitry configured to output the digital data stream using a single bus or multiple buses, which is functionally the same as the circuitry described in Pandey. Ex. 1013, [0038], [0039].

9. OPINIONS WITH RESPECT TO THE '866 PATENT

9.1. Summary of the Grounds and Comparison of Claim Limitations

91. The '866 patent has 6 independent claims (1, 14, 27, 41, 55, and 69) with 12-13 dependent claims each for a total of 82 claims. All of the claims are directed to a cable television (TV) device as illustrated in Figure 2 of the '866 patent.

92. Claims 1, 27, and 55 are nearly identical, with each reciting “a wideband analog-to-digital converter (ADC) configured to digitize a contiguous band of frequencies in an input signal ...” and “a digital front end (DFE) ... configured to concurrently select and provide each of the plurality of desired channels [] without providing any of the plurality of undesired channels.” Claims 1, 27, and 55 differ only by inclusion of a single, well-known ancillary feature: “a serial interface” (claim 1), “a digital video recorder” (claim 27), or “a picture-in-picture” display (claim 55).

93. Independent claims 14, 41, and 69 are nearly identical to claims 1, 27, and 55, respectively, and differ by replacing the “digital front end,” with “a plurality of digital down converters.” Claims 14, 41, and 69 also do not recite “a contiguous band of frequencies.” As shown in the detailed analysis below, both the “DFE” and the “plurality of digital down converters” are directed to the same structure illustrated, for example, as element 230 in Figure 2 of the '866 patent.

94. Zhang, the primary reference discloses every feature of claims 1, 14, 27, and 41, and thus anticipates these claims (ground A). To the extent Patent Owner argues that Zhang does not expressly disclose certain features, Zhang also renders claims 1, 14, 27, and 41 obvious (ground B). Zhang also discloses every feature of claims 55 and 69, but for “picture-in-picture.” For this feature, Reisman is combined with Zhang (ground C). Certain other features, such as “digital video recorder” in claims 27 and 41 are taught by both Zhang and Reisman, thus both references are relied upon, and thus grounds A, B, and C apply.

95. Additional grounds add Jackson (D/E) for teaching certain analog components and features of a complex mixer, and Pandey (F/G) for teaching serial and parallel interfaces. Grounds D and F omit Reisman for claims that depend from claims 1, 14, 27, and 41 and that do not include “picture-in-picture,” and grounds E and G include Reisman for claims that depend from claims 27, 41, 55 and 69 or that otherwise include “DVR” or “picture-in-picture.”

96. Finally, ground H adds Pandey to ground D (Zhang-Jackson). Grounds F/G, and H are applied as additional grounds in which Pandey supplements Zhang for teaching a “serial interface” or a “parallel interface” for outputting “desired channels”/“digital channel outputs.”

97. Because of the substantial overlap in features across different claims, this declaration refers back to previous sections where the same or similar claim

limitation has been previously addressed. In some cases, similar dependent claims having different base claims are treated together.

98. As I illustrate in the table below and address in the detailed analysis, each group of claims recite substantially duplicative limitations taught by the same combinations of prior art. The right six columns list the claims by group, with identical or similar claims/elements across groups listed in the same row. The column to the left of the claims/elements includes a brief descriptor of the common claimed feature for each row, and the left most column lists the ground associated with the combination of prior art that disclose or teach the feature. Colors indicate the group of grounds that apply to each claim/element.

Ground	Feature	Claim Groups					
		1-14	14-26	27-40	41-54	55-68	69-82
A/B A/B/C C	Cable TV device	1A	14A	27A	41A	55A	69A
	Wideband ADC	1B	14B	27B	41B	55B	69B
	Desired/Undesired channel input						
	Contiguous frequency input						
	Digital Front End	1C		27C		55C	
	Digital Down Converters		14C		41C		69C
	Desired channels	1C	14D				

	output via Serial interface						
	DVR			27D	41D		
	PIP					55D	69D
A/B A/B/C C	[Complex/Digital] Mixers each with I and Q complex outputs	3	16	29	43	57	71
	I and Q at baseband	4(3)	17(16)	30(29)	44(43)	58(57)	72(71)
	Filters for complex signal, complex signal is 6Mhz	5(3)	18(16)	31(29)	45(43)	59(57)	73(71)
	Demodulators demodulate the complex signals	6(3)	19(16)	32(29)	46(43)	60(57)	74(71)
	Demodulators demodulate a desired channel	7	20	33	47	61	75
	Desired channels comprise a cable broadcast channel	9	22	37	51	65	79
	Desired channel delivered with DOCSIS protocol	10	23	38	52	66	80

	DVR	11	24			67	81
	PIP	12	25	39	53		
	Channels comprises a portion of input frequency spectrum	13	26	40	54	68	82
	Desired channels output via Parallel interface			35	49	63	77
	Desired channels output via Serial interface			36	50	64	78
D D/E E	Cable Network Connector, Analog Amplifier, Analog Filter	2	15	28	42	56	70
	[Complex/Digital] Mixers each with I and Q complex outputs	3	16	29	43	57	71
	I and Q at baseband	4(3)	17(16)	30(29)	44(43)	58(57)	72(71)
	Filters for complex signal, complex signal is 6Mhz	5(3)	18(16)	31(29)	45(43)	59(57)	73(71)
	Demodulators demodulate the	6(3)	19(16)	32(29)	46(43)	60(57)	74(71)

	complex signals						
F F/G G	Provide demodulated channels via a parallel interface	8(7)	21(20)	34(33)	48(47)	62(61)	76(75)
F F/G G	Desired channels output via serial or parallel interface	1, 7, 9-13	14, 20, 22-26	35-36	49-50	63-64	77-78
H		2-6	15-19				

9.2. Ground A/B: Zhang (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)

99. In the following, I provide an element-by-element analysis showing how Zhang anticipates and renders obvious claims 1, 3-7, 9, 11, 13-14, 16-20, 22, 24, 26-27, 29-33, 35-37, 40-41, 43-47, 49-51, and 54. To help illustrate how the disclosures of these references map to the claim limitations, I have color coded some of my remarks and some figures in the noted art below.

9.2.1. Independent Claim 1

100. The elements of claim 1 appear in the Claims Listing Appendix, labeled as elements [1A]-[1C]. For the following reasons, it is my opinion that claim 1 is anticipated and rendered obvious by Zhang.

a. [1A]: “A cable television (TV) device comprising:”

101. It is my opinion that Zhang discloses “[a] cable television (TV) device comprising:” as claimed.

102. While the preamble [1A] is not limiting, it is my opinion that Zhang discloses it. Zhang describes an RF receiver, for example in a set-top box, that receives digital video channels over a cable system and that incorporates a DOCSIS return channel, which the ’866 patent concedes is a protocol for “cable networks that carry TV programs.” Ex. 1013, Fig. 2, [0005]-[0006], [0023]-[0025], [0029], [0041], [0045]-[0047], claims 13, 27, 30, 33; Ex. 1001, 9:4-8; Ex. 1021 at 1-3; Section 8.1, *supra*. A POSITA would thus have understood that Zhang’s receiver is a “cable television (TV) device” as recited in Element [1A].

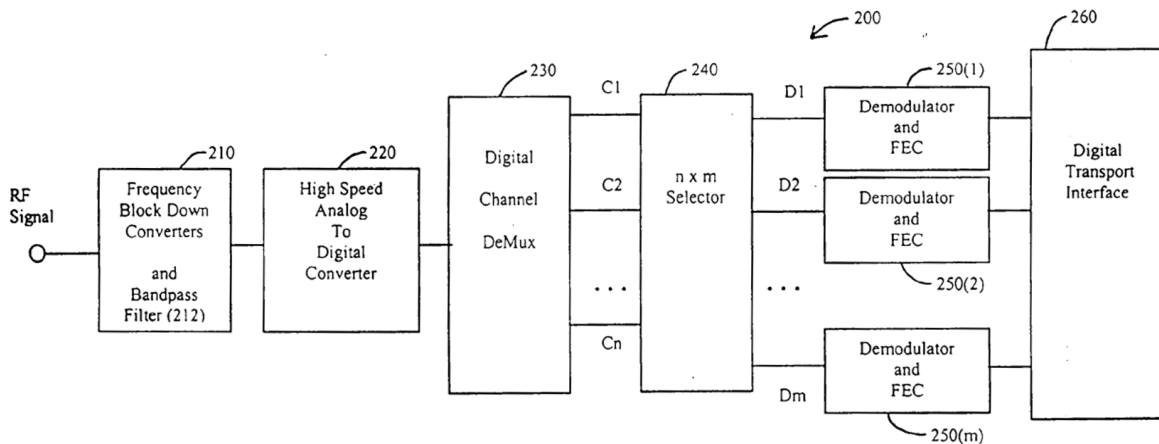


Fig. 2

Ex. 1013, Fig. 2

- b. [1B]: “a wideband analog-to-digital converter (ADC) configured to digitize a contiguous band of frequencies in an input signal, wherein the contiguous band of frequencies comprises a plurality of desired channels and a plurality of undesired channels; and”

103. It is my opinion that Zhang discloses “a wideband analog-to-digital converter (ADC) configured to digitize a contiguous band of frequencies in an input signal, wherein the contiguous band of frequencies comprises a plurality of desired channels and a plurality of undesired channels; and,” as claimed.

104. It is my opinion that Zhang discloses the claimed “wideband analog-to-digital converter,” for example, as described with respect to ADC 220 (gold), which digitizes a multi-channel analog RF signal received from Frequency Block Downconverter 210 (red). Ex. 1013, Abstract, [0010], [0025], [0027], [0031], [0034], [0044]-[0045], Figs. 2, 6-8, claims 1, 8.

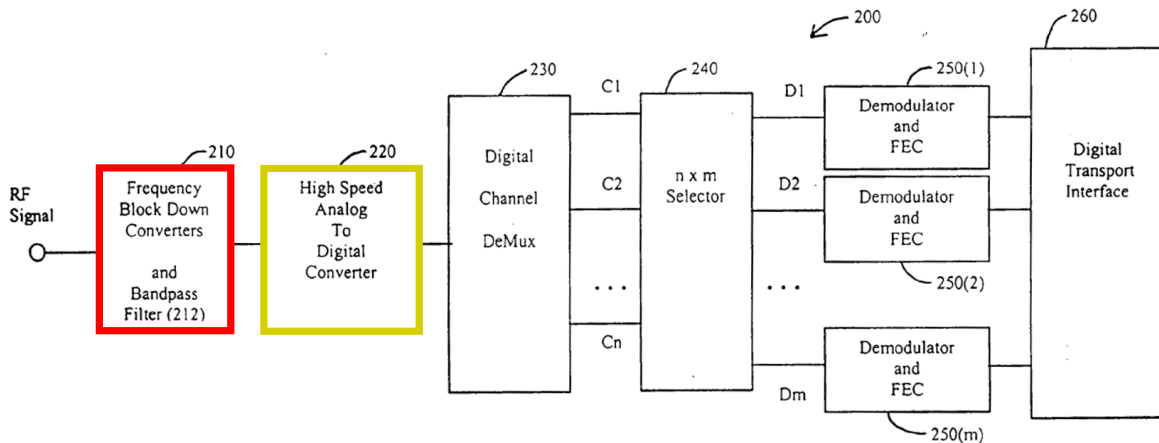


Fig. 2

Ex. 1013, Fig. 2 (annotated)

105. Zhang’s ADC is “wideband” because the digitized multi-channel RF signal includes several channels, and the channels form “a contiguous band of

frequencies” because (like the ’866 patent) they are spaced next to each other within a frequency band with a “precise frequency spacing” (e.g., 6MHz) that is a fraction of the total system bandwidth of the multi-channel RF signal (e.g., 540-750 MHz divided into 35 channels). *Compare* Ex. 1013, [0006], [0010], [0024]-[0025], [0027] (converting “an entire signal band”), [0041]-[0042], [0047] (receiving “an entire 500 MHz band”) *with* Ex. 1001, 1:26-38 (“tuners designed to concurrently receive several TV channels are referred to as wideband tuners”), 2:50-59 (contiguous channels have spacing “close to each other (e.g. as a fraction of the total system bandwidth . . .). Zhang also expressly states that in alternate variations of its system, “RF channels need not be contiguous,” which a POSITA would have understood, that in the embodiment described, the RF channels are contiguous. Ex 1013, [0048].

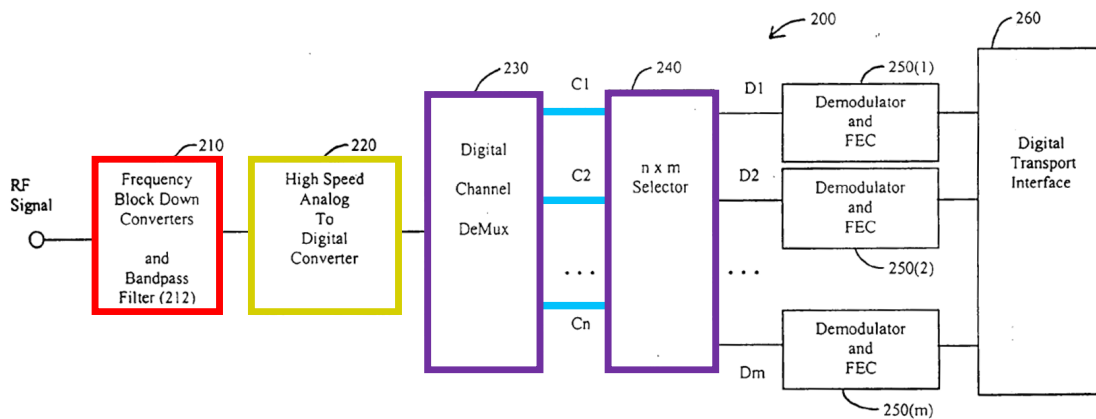
106. The digitized multi-channel RF signal includes “target” RF channels that are selected and demodulated in subsequent stages (the claimed “desired channels”), and undesired RF channels that are filtered out (the claimed “undesired channels”). Ex. 1013, [0005], [0010]-[0012], [0027]-[0029], [0031]-[0032], [0035]-[0036], [0041]-[0042], claims 1, 2, 4, 8, 21, 28, 34, 37.

107. Thus, it is my opinion that Zhang teaches Element [1B].

- c. [1C]: “a digital frontend (DFE) coupled to the wideband ADC, wherein the DFE is configured to concurrently select and provide each of the plurality of desired channels, via a serial interface, without providing any of the plurality of undesired channels;”

108. It is my opinion that Zhang discloses “a digital frontend (DFE) coupled to the wideband ADC, wherein the DFE is configured to concurrently select and provide each of the plurality of desired channels, via a serial interface, without providing any of the plurality of undesired channels,” as claimed.

109. It is my opinion that Zhang teaches the claimed “digital frontend (DFE)” as described with respect to Digital Channel Demultiplexer 230 and all or a portion of Digital Selector 240 (collectively **purple**), which are coupled to ADC 220. Ex. 1013, [0028].



Ex. 1013, Fig. 2 (annotated)

110. Digital Channel Demultiplexer 230 (below left), which has the same or equivalent structure as the '866 patent's digital front end 230 (below right), includes a plurality of signal paths for concurrently selecting 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. Like the '866 patent's digital front end, each path includes a complex multiplier 320 (purple) followed by a FIR low pass filter (LPF) 330 (green).

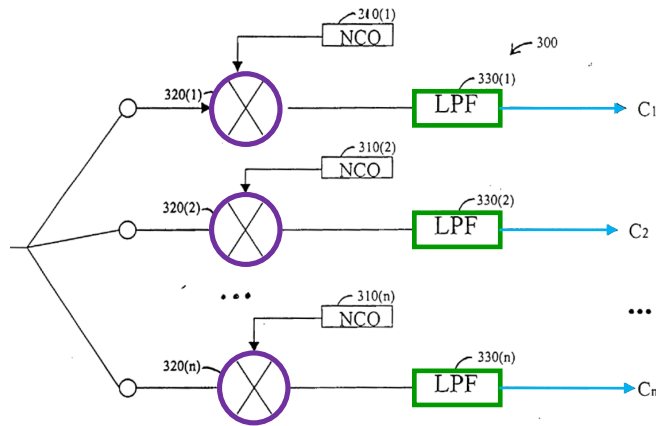
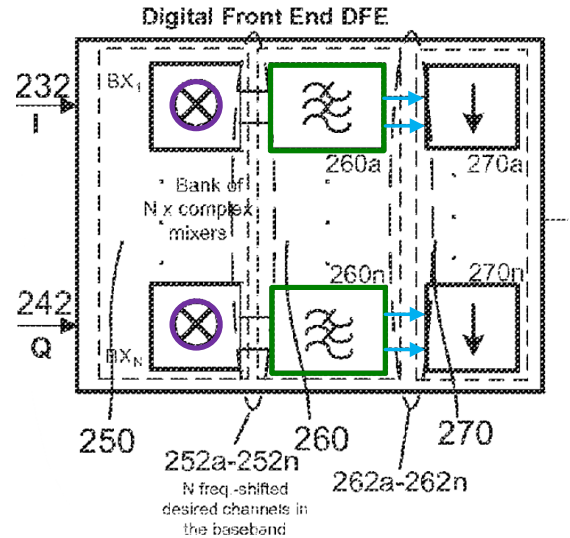


Fig. 3

Ex. 1013, Fig. 3 (annotated)



Ex. 1001, Fig. 2 (annotated)

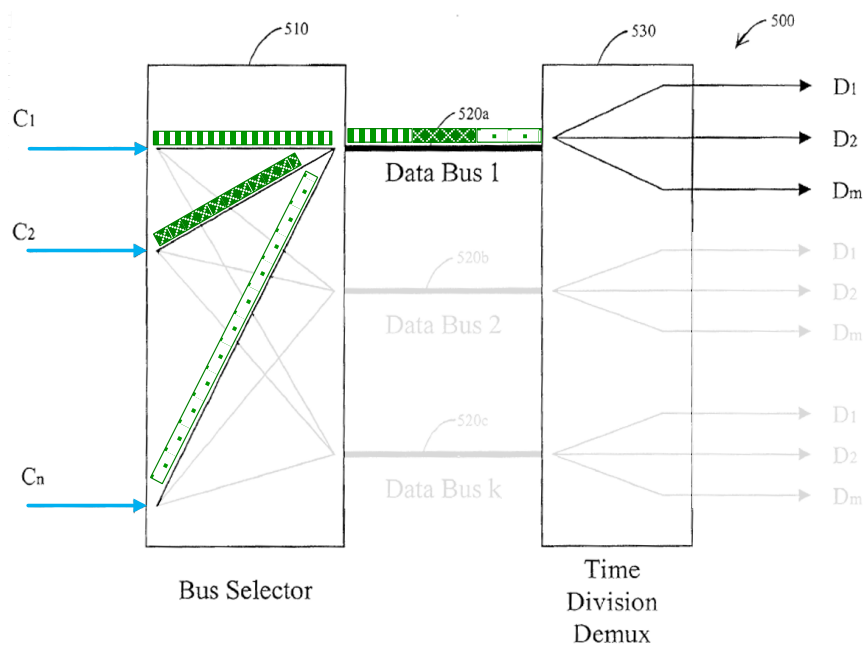
111. Each separate path receives the multi-channel RF signal from ADC 220 and operates concurrently and in a similar way to select one desired channel. Ex. 1013, [0031] (“In operation, digital tuner 300 receives the RF channels from an ADC, such as ADC 220 of FIG. 2, and then separates the RF channels C_1 to C_n , which are in the digital domain.”). In each path, complex multiplier 320 first shifts (downconverts) the frequency of the multi-channel RF signal so that a different “target channel” within the signal is centered at baseband (0 Hz), and then low pass filter 330 filters out all undesired channels, so that only “n” target channels $C_1 - C_n$

(light blue) are output. Ex. 1013, [0028] (“RF channels C_1 to C_n contain content channels that are selected or used by a subscriber.”), [0031]-[0032], claims 34, 36-37 (“filtering undesired RF channels and passing only the target RF channel”); *see also id.*, [0034]-[0037] (describing alternative embodiment with polyphase demultiplexer 400); Section 8.3, *supra*. Next, Digital Selector 240 provides “m” channels D_1 - D_m selected from one or more of channels C_1 - C_n (light blue) for demodulation by one or more demodulators. Ex. 1013, Figs. 2-3, [0005], [0028], [0038]-[0039], [0047], claims 2-4, 30. The “D” channels may include all “C” channels (light blue), or a subset of those channels. Ex. 1013, [0028], [0039], [0047], claims 2, 30, 32.

112. Collectively, Digital Channel Demultiplexer 230 and Digital Selector 240 output only user selected channels (either all or a subset of the user selected “C” channels) and filter out all other channels from the digitized multi-channel RF signal. Ex. 1013, [0028], [0039], [0047], claims 2, 30, 32. For example, Zhang discloses that “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 ” and that “RF channels C_1 to C_n contain content channels that are selected or used by a subscriber” and “ Ex. 1013, [0028]. Zhang thus discloses “a digital frontend (DFE) coupled to the wideband ADC, wherein the DFE is configured to concurrently select and provide each of the plurality of desired

channels ... without providing any of the plurality of undesired channels” as recited in Element [1C].

113. Digital Selector 240 further includes “a serial interface” as recited in Element [1C]. Digital Selector 240, as illustrated in Figure 5, includes a bus selector 510, one or more multiple data buses 520, and a time division demultiplexer 530. Ex. 1013, [0038]-[0039], Fig. 5. Digital Selector 240 may have only a single bus (e.g., Data bus 1) that receives channels C_1 to C_n from the Channel Demultiplexer 230 (represented by green blocks with different cross hatch patterns) and sends the channels to demodulators 250 “with the use of time division multiplexing.” *Id.*; Ex. 1016 at 79-80 (Fig. 6-25).



Ex. 1013, Fig. 5 (annotated)

114. A POSITA would have understood (as supported by numerous dictionaries, basic text books and technical papers at the time) that Zhang's time division multiplexing involves sending different channels sequentially in different time divisions over a single data path as shown, and that such a path was known as a "serial interface" as claimed in Element [1C]. Ex. 1013, [0038]-[0039]; Ex. 1014, 30:31-42, 31:15-22; Ex. 1015 at 8 (defining "serial interface"); Ex. 1016 at 79-80 (Figure 6-25); Ex. 1017 at 354-355; Ex. 1034 at 23, 183; Ex. 1048 at 16; Ex. 1049, 1:10-40; *see* Section 8.4, *supra*.

115. For example, as explained in the textbook "Digital Integrated Circuits: A Design Perspective" published in 1996 ("Rabaey"), a digital circuits represent data as binary units (referred to as "bits") in the form of electrical signals on wires (e.g., high and low voltages for binary values "1" and "0" respectively). Ex. 1016 at 32-33, *see also* 34-39, 49-51, 79-80 (Figure 6-25). To output multiple bits (e.g., from multiple channels), the circuit can either transmit the bits over multiple separate wires, one wire for each bit, which was known as a "parallel interface," or the circuit can transmit the set of bits one at a time as sequential pulses over a single wire, according to a fixed sequence, which was known as a "serial interface." Ex. 1016 at 79-80 (Figure 6-25); Ex. 1015 at 6, 8.

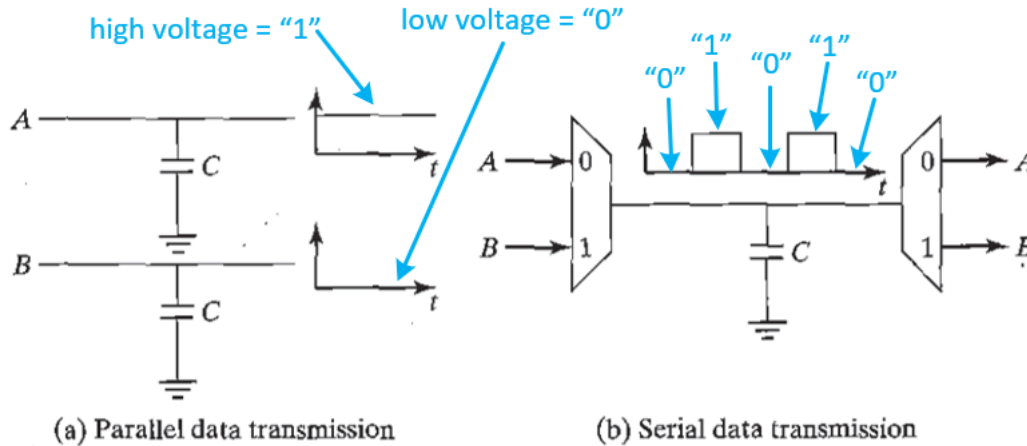


Figure 6-25 Parallel versus time-multiplexed data busses.

Ex. 1016 at 80 (Figure 6-25) (annotated)

116. As shown in Zhang's annotated Figure 5 above, Zhang implements a "serial interface" as this term is described in Rabaey and as was known in the art.

117. To the extent Patent Owner argues that Zhang does not disclose a serial interface, it is my opinion that implementing Zhang's circuitry to output the selected channels to demodulators 250 (either to an individual demodulator or to shared demodulators) via a serial interface would have been obvious in light of the POSITA's general knowledge, creativity, and common sense as one of two common design choices that were well known and used by POSITAs in integrated circuit designs at the time. Ex. 1014, 30:31-42, 31:15-22; Ex. 1015 at 8 (defining "serial interface"); Ex. 1016 at 79-80; Ex. 1017 at 354-355. Indeed, as the '866 patent concedes, outputting a digital data stream via serial interface was "commonly known," i.e., Applicant Admitted Prior Art (AAPA). Ex. 1001, 7:10-14. For the

same reasons, implementing a serial interface would have been well within the POSITA's skillset, and thus, a POSITA selecting either interface would have had a high expectation of success leading to a predictable result.

118. Further, Zhang discloses that its circuit may be implemented in CMOS, which as was discussed above with respect Rabaey, can either transmit the bits over multiple separate wires, one wire for each bit, which was known as a "parallel interface," or the circuit can transmit bits sequentially over a single wire, which was known as a "serial interface." Ex. 1016 at 79-80 (Figure 6-25). A POSITA implementing the Zhang circuit, would have been aware of and fully able to implement a serial interface and/or a parallel interface, both options being obvious to try as typical and practical choices. For the same reasons, implementing serial and parallel interfaces would have been well within the POSITA's skillset, and thus, a POSITA selecting either interface would have had a high expectation of success leading to a predictable result.

119. Thus, Digital Channel Demultiplexer 230 and Digital Selector 240 collectively disclose and teach as obvious the claimed "digital frontend (DFE) coupled to the wideband ADC, wherein the DFE is configured to concurrently select and provide each of the plurality of desired channels, via a serial interface, without providing any of the plurality of undesired channels" as recited in Element [1C].

120. To the extent “DFE” is a means-plus-function limitation, Zhang discloses the same or equivalent structure as in the ’866 patent (e.g., multiple paths, each including a complex and filter as shown in Figures 2 and 3 of Zhang and Figure 2 of the ’866 patent), with any differences being insubstantial. Ex. 1013, Abstract, [0010], [0025], [0027], [0031], [0034], [0044]-[0045], Figs. 2, 3; Ex. 1001, Figs. 2-3, 5:51-7:9, 9:50-60. In Zhang and the ’866 patent, each path performs the same function of selecting a respective desired channel, in the same way by first downconverting the respective desired channel to baseband and then low pass filtering with a filter to isolate the channel, to achieve the same result of generating a digital channel output corresponding to a respective desired channel. *Id.*

9.2.2. Independent Claim 14

121. The elements of claim 14 appear in the Claims Listing Appendix, labeled as elements [14A]-[14D]. It is my opinion that claim 14 is anticipated and rendered obvious by Zhang.

a. [14A]: “A cable TV device comprising:”

122. It is my opinion that Zhang discloses “[a] cable TV device comprising:” as claimed. Element [14A] is identical to Element [1A], and thus disclosed by Zhang for the same reasons discussed above with respect to Elements [1A]. *See* Section 9.2.1.a, *supra*.

- b. [14B]: “a wideband analog-to-digital converter (ADC) configured to digitize an input signal, wherein the input signal comprises a plurality of desired channels and a plurality of undesired channels; and;”**

123. It is my opinion that Zhang discloses “a wideband analog-to-digital converter (ADC) configured to digitize an input signal, wherein the input signal comprises a plurality of desired channels and a plurality of undesired channels; and,” as claimed.

124. Element [14B] and Element [1B] are directed to a substantially identical “wideband analog-to-digital converter.” Both ADCs are configured to digitize an input signal that comprises “a plurality of desired channels and a plurality of undesired channels.” Element [1B] additionally requires that the desired and undesired channels are comprised in “a contiguous band of frequencies” in the input signal. Since Element [1B] includes all of the features of Element [14B], Zhang discloses Element [14B] for the same reasons discussed above with respect to Element [1B]. *See* Section 9.2.1.b, *supra*.

- c. [14C]: “a plurality of digital down converters coupled to the wideband ADC, wherein each digital downconverter, of the plurality of down converters, is operable to generate a digital channel output corresponding to each desired channel, of the plurality of desired channels, and”**

125. It is my opinion that Zhang discloses “a plurality of digital down converters coupled to the wideband ADC, wherein each digital downconverter, of the plurality of down converters, is operable to generate a digital channel output

corresponding to each desired channel, of the plurality of desired channels,” as claimed. As I discuss above, a POSITA would have understood “a plurality of digital down converters” to be included in the DFE digital circuit illustrated in the ’866 patent Figure 2. *See* Sections 6.2, 9.2.1.c, *supra*. As I also describe above, the DFE is the same circuit to which Element [1C] is directed to *See* Section 9.2.1.c, *supra*. Thus, it is my opinion that Zhang discloses Element [14C] for the same reasons I describe above with respect to Element[1C].

126. Zhang’s Digital Channel Demultiplexer 230 (below left), which has the same structure as the ’866 patent’s digital front end 230 (below right), includes a plurality of signal paths, each including a complex multiplier 320 (**purple**) and filter 330 (**green**) (collectively the claimed “plurality of digital down converters”), that are coupled to ADC 220 (the claimed “wideband ADC”) and operable to generate “target” channels $C_1 - C_n$ (**light blue**) selected by the subscriber (the claimed “desired channels”). *Compare* Ex. 1013, Fig. 3 (320, 330), [0030]-[0032], claims 10-11, 21, 34-36 *with* Ex. 1001, Fig. 2 (250, 260), 2:65-3:2, 6:3-12, 6:50-63, 7:47-55.

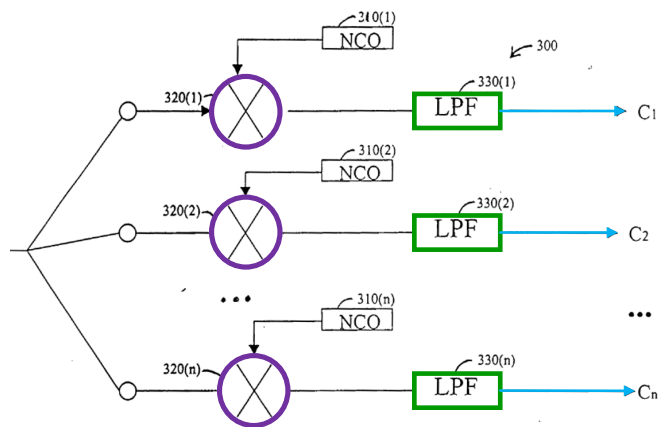
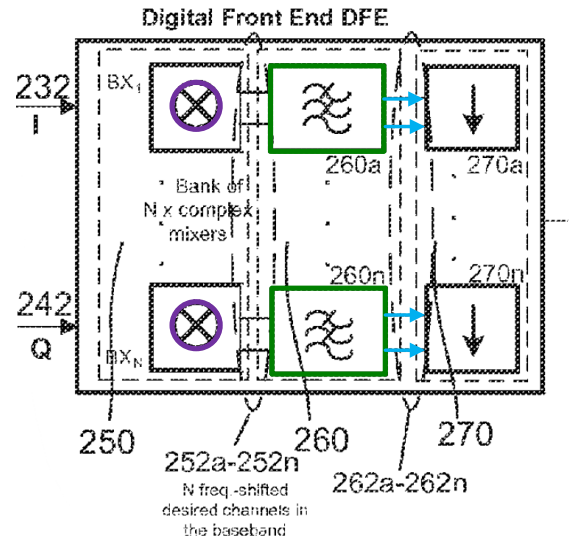


Fig. 3

Ex. 1013, Fig. 3 (annotated)



Ex. 1001, Fig. 2 (annotated)

127. As in the '866 patent, Zhang's Digital Channel Demultiplexer 230 includes numeric controlled oscillators (NCOs) 310(1)-310(n) that provide to the complex multipliers 320(1)-320(n) the target frequencies of channels $C_1 - C_n$, which the complex multipliers then down convert to baseband (0 Hz), and which low pass filters (LPFs) 330(1)-330(n) isolate by filtering out undesired channels. *Compare* Ex. 1013, Fig. 3, [0012], [0028], [0031]-[0032], claims 11, 21, 34, 36-37 with Ex. 1001, Fig. 2, 6:3-8, 6:50-63. Each path in Zhang's Digital Channel Demultiplexer 230 all operate in a similar way, which would enable each of Zhang's paths to generate any of the desired channels on outputs $C_1 - C_n$ (or a subset of these outputs). Ex. 1013, [0031]. Thus, each of Zhang's complex multiplexer/NCO/filter path (the claimed "digital down converter") is "operable to generate a digital channel output

corresponding to each desired channel, of the plurality of desired channels” as recited in Element [14C]. *Id.*

128. Moreover, to the extent “digital down converter” were to be construed as a means-plus-function term, as I have shown above, Zhang’s demultiplexer 230 includes the same or equivalent structure as disclosed in the ’866 patent (e.g., multiple parallel paths, each including a complex mixer followed by a low pass filter as shown in Figures 2 and 3 of Zhang and Figure 2 of the ’866 patent). Though the ’866 patent additionally illustrates decimators 270 in the DFE, these are described as optional, and nonetheless are not required for performing the function in Element [14C]. Thus, any difference between the structures in Zhang and the ’866 patent are insubstantial. In both Zhang and the ’866 patent, each path performs the same function of selecting a respective desired channel, in the same way by first downconverting the respective desired channel to baseband and then low pass filtering with a filter to isolate the channel, to achieve the same result of generating a digital channel output corresponding to a respective desired channel.

d. [14D]: “wherein the plurality of digital down converters is operable to provide each digital channel output via a serial interface.”

129. It is my opinion that Zhang discloses “wherein the plurality of digital down converters is operable to provide each digital channel output via a serial interface,” as claimed.

130. As shown below, each path in Zhang’s Digital Channel Demultiplexer 230 (the claimed “plurality of digital down converters”) provides channels $C_1 - C_n$ (light blue) (which include each claimed “digital channel output”) via a Digital Selector 240 as channels $D_1 - D_m$ to one or more demodulators 250. Ex. 1013, [0005], [0028], [0038]-[0039], [0047], claims 2-4, 30.

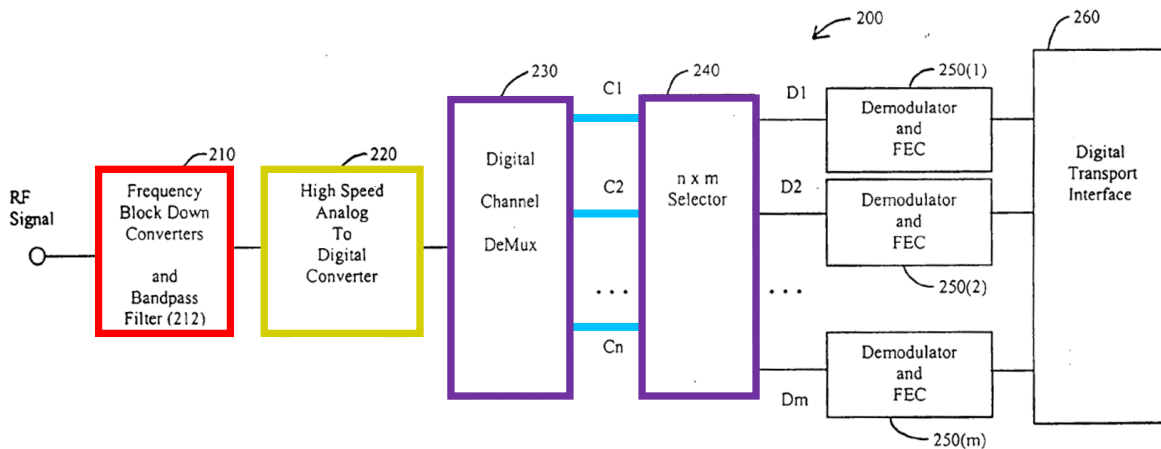
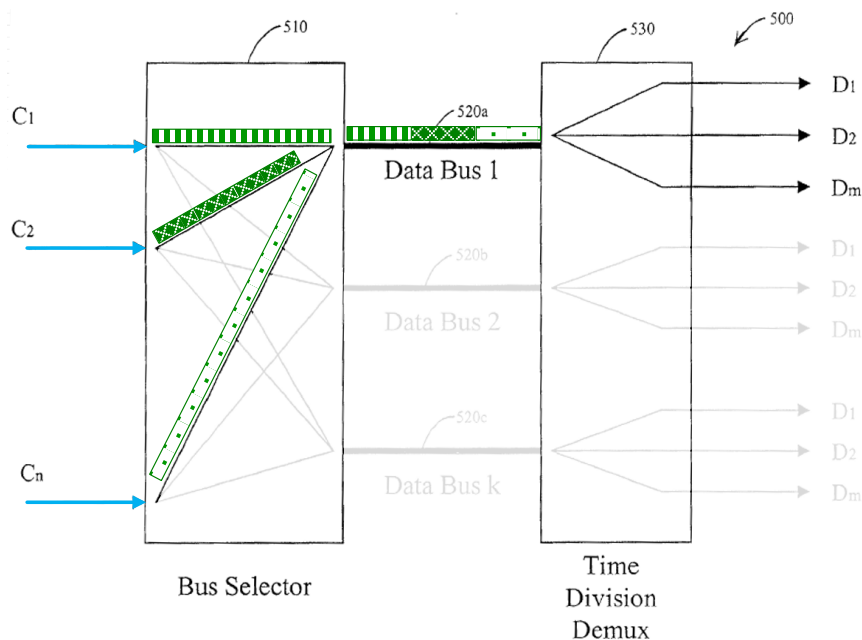


Fig. 2

Ex. 1013, Fig. 2 (annotated)

131. As I discuss above with respect to Element [1C] and as annotated below, Zhang’s Digital Selector 240 includes the claimed “serial interface.” Digital Selector 240 may include a bus selector 510 that time division multiplexes channels C_1 to C_n serially over “one” data bus 520. Ex. 1013, [0038]-[0039], Fig. 5; *see* Section 9.2.1.c, *supra*. The single bus (e.g., Data bus 1) receives channels C_1 to C_n from the Channel Demultiplexer 230 (represented by green blocks with different cross hatch patterns) and sends all or a subset of these channels to demodulators 250

“with the use of time division multiplexing.” Ex. 1013, [0028], [0038], [0039], claims 2-4, 30, 32, Fig. 5; Ex. 1016 at 80 (Figure 6-25).



Ex. 1013, Fig. 5 (annotated)

132. A POSITA would have understood that Zhang’s time division multiplexing involves sending different channels sequentially in different time divisions over a single data path as shown, and that such a path was known as a “serial interface.” Ex. 1013, [0038], [0039]; Ex. 1014, 30:31-42, 31:15-22; Ex. 1015 at 8 (defining “serial interface”); Ex. 1016 at 31-34, *see also id.* at 49-51, 79-80 (Figure 6-25); Ex. 1017, 354-355. Zhang’s Digital Channel Demultiplexer 230, which includes the claimed “plurality of digital down converters,” provide the desired channels in C₁-C_n “via a serial interface” (via Bus Selector 510/Data Bus 1) in Digital Selector 240, and thus discloses Element [14D].

133. To the extent Patent Owner argues that Zhang does not expressly disclose the claimed “serial interface,” I understand that such an interface was notoriously well known, and implementing Zhang’s plurality of digital down converters to provide the desired channels to demodulators 250 via a serial interface would have been obvious based on a POSITA background knowledge, creativity, and common sense as one of two identified and predictable design choices used by POSITAs at the time as described above with respect to Element [1C]. *See, e.g.,* Ex. 1014, 30:31-42, 31:15-22; Ex. 1015 at 8 (defining “serial interface”); Ex. 1016 at 37-39, *see also id.* at 33-34, 49-51 80 (Figure 6-25); Ex. 1017, 354-355. Indeed, as the ’866 patent concedes, outputting a digital data stream via serial interface was “commonly known,” i.e., Applicant Admitted Prior Art (AAPA). Ex. 1001, 7:10-13.

134. For example, as explained in the textbook “Digital Integrated Circuits: A Design Perspective” published in 1996 (“Rabaey”), CMOS digital circuits (the technology used in Zhang) transmit data as binary units (referred to as “bits”) either in parallel, i.e., over multiple separate wires, one wire for each bit, or over a serial interface, i.e., one bit at a time as sequential pulses over a single wire, according to a fixed sequence. Ex. 1016 at 33-34, 37-39, 49-51, 80 (Figure 6-25); Ex. 1015 at 5.

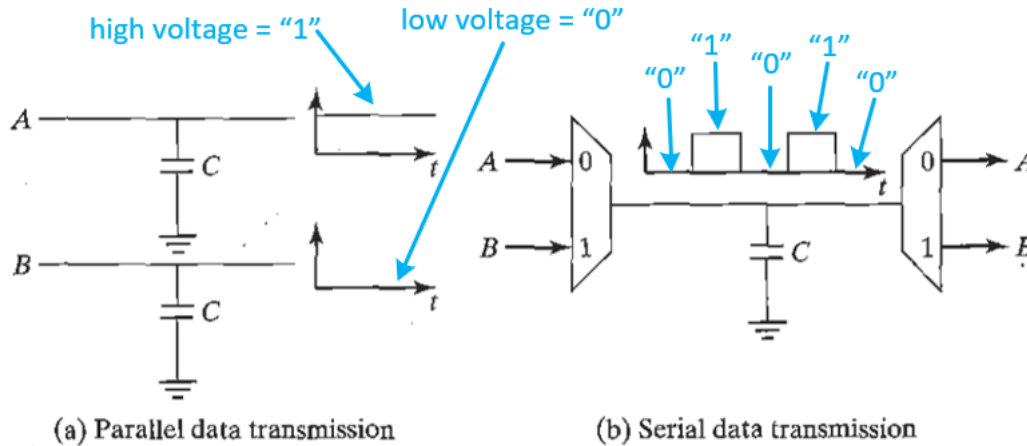


Figure 6-25 Parallel versus time-multiplexed data busses.

Ex. 1016 at 80 (Figure 6-25) (annotated)

135. A POSITA would thus have found it obvious to implement Zhang's plurality of digital down converters to provide the desired channels to demodulators 250 "via a serial interface" as one of two identified and predictable design choices that used by POSITAs in CMOS integrated circuits designs at the time. Ex. 1014, 30:31-42, 31:15-22; Ex. 1015 at 8 (defining "serial interface"); Ex. 1016 at 53-54; Ex. 1017 at 354-355. For the same reasons, implementing a serial interface would have been well within the POSITA's skillset, and thus, a POSITA implementing a serial interface would have had a high expectation of success leading to a predictable result.

136. Thus, Digital Channel Demultiplexer 230 and Digital Selector 240 collectively disclose and teach as obvious the claimed "wherein the plurality of digital down converters is operable to provide each digital channel output via a serial

interface” as recited in Element [14D]. Thus, Zhang also renders obvious (ground B) Element [14D].

9.2.3. Independent Claim 27

[27A] “A cable television (TV) device comprising:”

[27B] “a wideband analog-to-digital converter (ADC) configured to digitize a contiguous band of frequencies in an input signal, wherein the contiguous band of frequencies comprises a plurality of desired channels and a plurality of undesired channels; and”

[27C] “a digital frontend (DFE) coupled to the wideband ADC, wherein the DFE is configured to concurrently select and provide each of the plurality of desired channels without providing any of the plurality of undesired channels, and”

[27D] “wherein the cable TV device comprises a digital video recorder (DVR).”

137. The elements of claim 27 appear in the Claims Listing Appendix, labeled as elements [27A]-[27D]. For the following reasons, it is my opinion that claim 27 is anticipated and rendered obvious by Zhang.

138. Elements [27A]-[27C] are identical to Elements [1A]-[1C], except that Element [27C] does not include the Element [1C] limitation “via a serial interface.” Elements [27A]-[27C] are thus anticipated and rendered obvious by Zhang for the same reasons discussed above with respect to Elements [1A]-[1C]. *See* Sections 9.2.1.a-c, *supra*.

139. It is my opinion that Zhang further discloses Element [27D]. Zhang discloses that its cable TV device as described above with respect to Elements [1A]-[1C] and [27A]-[27C] may be integrated as a wide-band front-end of a “set-top

box/PVR/home media server.” Ex. 1013, [0045], Fig. 8 (“PVR storage”). A POSITA would have understood that “PVR” stands for “personal video recorder,” which is an alternate name for “DVR” or “digital video recorder,” which is a device for recording audio and video content, for example, received by a set-top box. Ex. 1051, [0018] (“A PVR is also referred to as [] digital video recorder (DVR)”); Ex. 1052, [0048], [0060] (“Digital Video Recorders (DVRs, also known as Personal Video Recorders, PVRs)”).

140. Claim 27 is thus anticipated (ground A) and rendered obvious (ground B) based on Zhang.

9.2.4. Independent Claim 41

[41A] “A cable TV device comprising:”

[41B] “a wideband analog-to-digital converter (ADC) configured to digitize an input signal, wherein the input signal comprises a plurality of desired channels and a plurality of undesired channels; and”

[41C] “a plurality of digital down converters coupled to the wideband ADC, 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, and”

[41D] “wherein the cable TV device comprises a digital video recorder (DVR).”

141. The elements of claim 41 appear in the Claims Listing Appendix, labeled as elements [41A]-[41D]. For the following reasons, it is my opinion that claim 41 is anticipated and rendered obvious by Zhang.

142. Elements [41A]-[41C] are identical to Elements [14A]-[14C] and directed to substantially the same subject matter as Elements [1A]-[1C], and Elements [27A]-[27C], and thus are disclosed and taught as obvious by Zhang for the same reasons discussed above with respect to Elements [1A]-[1C], Elements [14A]-[14C], and Elements [27A]-[27C]. *See* Sections 9.2.1.a-c, 9.2.2.a-c, 9.2.3, *supra*.

143. Element [41D] is identical to Element [27D], and thus taught by Zhang, described above with respect to Element [27D]. *See* Section 9.2.3, *supra*.

144. Accordingly, claim 41 is anticipated (ground A) and rendered obvious (ground B) by Zhang. *See* Sections 9.2.1.a-c, 9.2.2.a-c, 9.2.3, *supra*.

9.2.5. Dependent Claims 9, 22, 37, 51

[9/22/37/51] “The cable TV device of claim [1/14/27/41], wherein: the plurality of desired channels comprises at least one cable broadcast channel.”

145. It is my opinion that Zhang describes “[t]he cable TV device of claim [1/14/27/41], wherein: the plurality of desired channels comprises at least one cable broadcast channel,” as recited in claims 9/22/37/51.

146. Zhang discloses that desired channels are “cable downstream signals” transmitted in a cable system to set-top boxes within a “540-750MHz” frequency band, and comprise data streams “pre-programmed” by a program provider, and “accessed or used by [plural] subscribers.” Ex. 1013, [0005]-[0007], [0024], [0029],

[0041], [0045], [0047], claims 13, 27, 33. In general and as the '866 patent describes in its background section, “television channels broadcasted over the air or over cable networks are distributed across a broad frequency spectrum.” Ex. 1001, 1:46-48. It is my opinion that a POSITA would have understood Zhang’s cable downstream signals are each a “cable broadcast channel” as claimed, because they are transmitted over a cable network to multiple subscribers and are transmitted in a frequency band reserved in the United States for broadcasting digital video. Ex. 1033 at 22, 30, 40, 352; Ex. 1034 at 20-21.

147. Thus, Zhang anticipates (ground A) and renders obvious (ground B) claims 9, 22, 37, 51, which depend from claims 1, 14, 27, and 41, respectively.

9.2.6. Dependent Claims 11, 24

[11/24] “The cable TV device of claim [1/14], wherein: the cable TV device comprises a digital video recorder (DVR).”

148. It is my opinion that Zhang discloses “[t]he cable TV device of claim [1/14], wherein: the cable TV device comprises a digital video recorder (DVR),” as recited in claims 11/24.

149. Claims 11 and 24 recite the identical limitation as Element [27D], and thus these claims are disclosed (ground A) and rendered obvious (ground B) by Zhang, for the same reasons discussed above with respect to their base claims 1 and 14, respectively, and for Zhang’s additional teaching of DVR as described above with respect to Element [27D]. *See* Sections 9.2.1-3, *supra*.

9.2.7. Dependent Claims 13, 26, 40, 54

[13/40] “The cable TV device of claim [1/27], wherein: the contiguous band of frequencies comprises a portion of a frequency spectrum of the input signal.”

[26/54] “The cable TV device of claim [14/41], wherein: the plurality of desired channels and the plurality of undesired channels comprise a portion of a frequency spectrum of the input signal.”

150. It is my opinion that Zhang discloses “[t]he cable TV device of claim [1/27], wherein: the contiguous band of frequencies comprises a portion of a frequency spectrum of the input signal,” as recited in claim 13/40, and “[t]he cable TV device of claim [13/40], wherein: the plurality of desired channels and the plurality of undesired channels comprise a portion of a frequency spectrum of the input signal,” as recited in claims 26/54.

151. Claims 13 and 40 (including their base claims 1 and 27) require that the ADC is “[configured to digitize a contiguous band of frequencies in an input signal,] wherein: the contiguous band of frequencies comprises a portion of a frequency spectrum of the input signal.” Claims 26 and 54 (including their base claims 14 and 41) require that the ADC is “[configured to digitize an input signal] wherein: the plurality of desired channels and the plurality of undesired channels comprise a portion of a frequency spectrum of the input signal.”

152. As I discuss above (e.g., with respect to Element [1B]), Zhang’s ADC 220 digitizes a multi-channel RF signal that has been downconverted to an IF frequency by Frequency Block Down Converter 210, where the multi-channel RF

signal includes a contiguous band of frequencies of desired and undesired channels. *See* Section 9.2.2.b, *supra* I note that the existence of Zhang's contiguous band of frequencies being within the digitized multi-channel RF signal, means it necessarily comprises "a portion of a frequency spectrum of the input signal" as recited in claims 13, 26, 40, and 54. However, to the extent required by claims 13, 26, 40, and 54, Zhang further discloses that the contiguous band of frequencies may have a bandwidth that is less than what the ADC is capable of digitizing. Ex. 1013, [0025], [0042]. For example, the ADC may sample at 300 MHz, thus digitizing an input signal having a bandwidth of 0-150 MHz due to the Nyquist theorem, whereas the desired and undesired channels may only comprise a portion of this spectrum from 20-130 MHz. Ex. 1013, [0025], [0041]-[0042] ("Each group is down converted to a lower frequency band of 20-130 MHz so that the groups can be processed by respective 300- MHz ADCs 620a and 620b."); Ex. 1045 at 70 (the Nyquist theorem specifies that a sinusoidal function in time or distance can be regenerated with no loss of information as long as it is sampled at a frequency greater than or equal to twice per cycle); Ex. 1033 at 98-99.

153. Thus, it is my opinion that Zhang discloses the features of claims 13, 26, 40, and 54. Accordingly, it is my view that Zhang anticipates (ground A) and renders obvious (ground B) claims 13, 26, 40, and 54.

9.2.8. Dependent Claims 35, 49

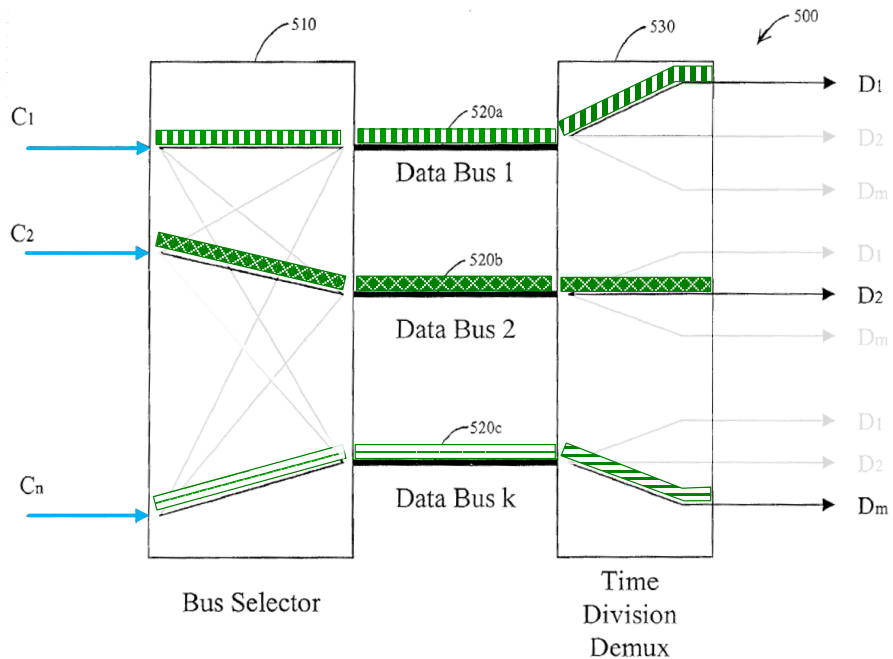
[35] “The cable TV device of claim 27, wherein: the DFE is operable to provide the plurality of desired channels via a parallel interface.”

[49] “The cable TV device of claim 41, wherein: the plurality of digital down converters is operable to provide a plurality of digital channel outputs, comprising each digital channel output, via a parallel interface.”

154. It is my opinion that Zhang discloses “[t]he cable TV device of claim 27, wherein: the DFE is operable to provide the plurality of desired channels via a parallel interface,” as recited in claim 35, and “[t]he cable TV device of claim 41, wherein: the plurality of digital down converters is operable to provide a plurality of digital channel outputs, comprising each digital channel output, via a parallel interface,” as recited in claim 49.

155. As I discuss above with respect to Elements [1C] and [14D], Zhang’s Digital Channel Demultiplexer 230 and Digital Selector 240 collectively output the “plurality of desired channels”/“plurality of digital channel outputs,” which are provided to demodulators 250 via one or more buses in Digital Selector 240. *See* Sections 9.2.1.c, 9.2.2.d. As I also discuss above, in the case of a single bus using “time division multiplexing,” Digital Selector 240 is arranged as the “serial interface” recited in Elements [1C] and [14D]. *Id.*

156. Zhang also describes other arrangements of Digital Selector 240, for example a version providing the channels “through different data buses.” Ex. 1013, [0038]-[0039], Fig. 5. An example of this variation is annotated below. *Id.*



Ex. 1013, Fig. 5 (annotated)

157. It is my opinion that a POSITA would understand this arrangement to be a “parallel interface” as recited in claims 35 and 49. Ex. 1013, [0038]-[0039]; Ex. 1014, 30:31-42, 31:15-22; Ex. 1015 at 6; Ex. 1016 at 79-80 (Figure 6-25); Ex. 1017 at 354-355; Ex. 1034 at 23, 183; Ex. 1048 at 16; Ex. 1049, 1:10-40;; *see* Section 8.4, *supra*.

158. To the extent Patent Owner argues that Zhang does not expressly disclose the claimed “parallel interface,” it is my opinion that such an interface was notoriously well known, and implementing Zhang’s Digital Channel Demultiplexer 230 and Digital Selector 240 to provide the channels “via a parallel interface” would have been obvious based on a POSITA’s background knowledge, creativity, and common sense. *See, e.g.,* Ex. 1014, 30:31-42, 31:15-22; Ex. 1015, at 6; Ex. 1016

at 23, 49-51, 79-80 (Figure 6-25); Ex. 1034, pp. 23, 183; Ex. 1048, p. 16; Ex. 1049, 1:10-40; Ex. 1017 pp. 354-355. Indeed, as the '866 patent concedes, outputting a digital data stream via a parallel interface was “commonly known.” . Ex. 1001, 7:10-14.

159. For example (as discussed above with respect to Element [14D]), I understand that it was well known that digital circuits implemented in CMOS (the technology used in Zhang) transmit data either in parallel or in serial. *See* Section 9.2.2.d, *supra*; Ex. 1016 at 23, 49-51, 80 (Figure 6-25); Ex. 1015 at 5-6.

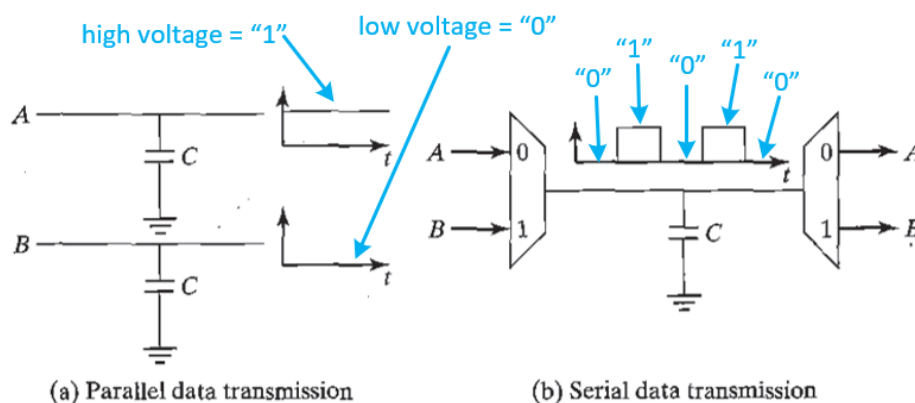


Figure 6-25 Parallel versus time-multiplexed data busses.

Ex. 1016 at 80 (Figure 6-25) (annotated)

160. Thus, a POSITA implementing Zhang’s circuits to provide the desired channels to demodulators 250 would have simply been choosing “a parallel interface” as one of two identified design choices that were used in CMOS integrated circuit designs at the time. Ex. 1014, 30:31-42, 31:15-22; Ex. 1015, at 6; Ex. 1016 at 79-80; Ex. 1017 at 354-355. For the same reasons, I understand that implementing

a serial interface would have been well within the POSITA's skillset, and thus, a POSITA implementing a parallel interface would have had a high expectation of success leading to a predictable result.

161. Thus, it is my opinion that Zhang's Digital Channel Demultiplexer 230 and Digital Selector 240 collectively anticipate (ground A) and render obvious (ground B) claims 35 and 49 (depending from claims 27 and 41, respectively).

9.2.9. Dependent Claims 36, 50

[36] "The cable TV device of claim 27, wherein: the DFE is operable to provide the plurality of desired channels via a serial interface."

[50] "The cable TV device of claim 41, wherein: the plurality of digital down converters is operable to provide each digital channel output via a serial interface."

162. It is my opinion that Zhang discloses "[t]he cable TV device of claim 27 wherein: the DFE is operable to provide the plurality of desired channels via a serial interface," as recited in claim 36, and "[t]he cable TV device of claim 41, wherein: the plurality of digital down converters is operable to provide each digital channel output via a serial interface," as recited in claim 50.

163. Claim 36 is substantially identical to the Element [1C] limitation of "wherein the DFE is configured to [] provide each of the plurality of desired channels, via a serial interface," and claim 50 recites the identical limitation as Element [14D]. As I discuss above, Zhang discloses these limitations. *See* Sections 9.2.1.c, 9.2.2.d, *supra*.

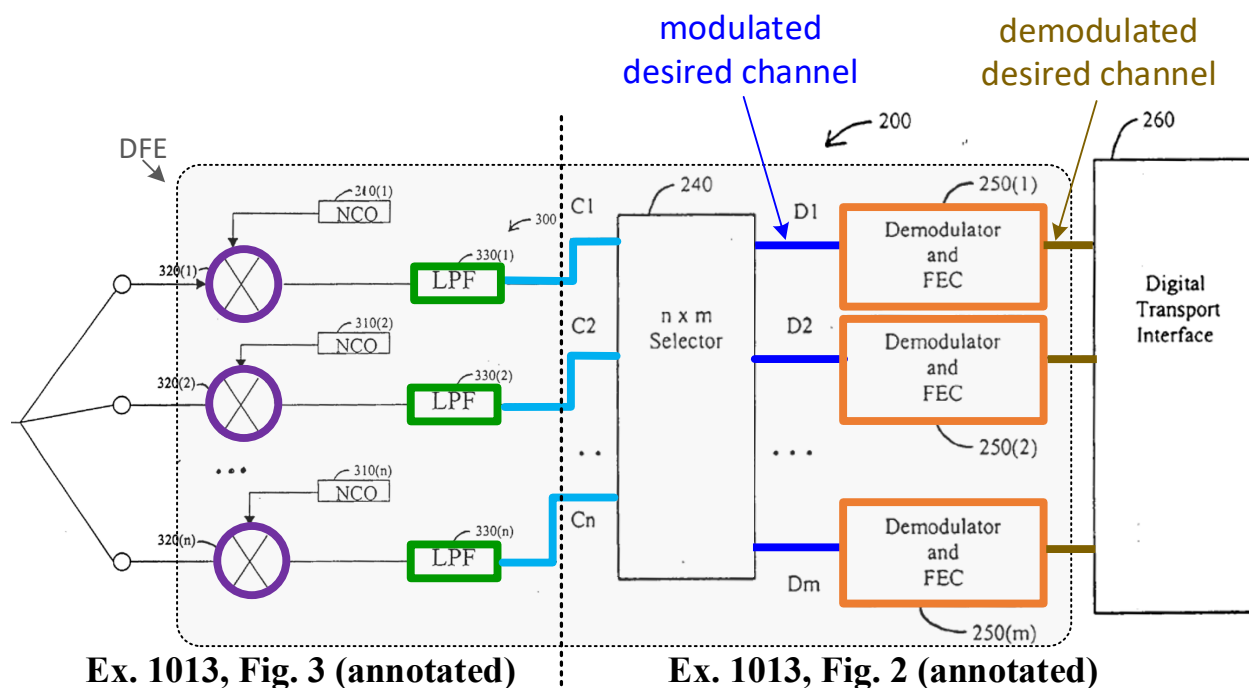
164. Thus, it is my opinion that claims 36 and 50 are anticipated (ground A) and rendered obvious (ground B) by Zhang, for the same reasons discussed as their base claims 27 and 41, respectively, and for Zhang’s additional teaching (alone or with the knowledge of the POSITA) of the serial interface as described with respect to Elements [1C] and [14D]. *See* Sections 9.2.1.c, 9.2.2.d, 9.2.3, 9.2.4, *supra*.

9.2.10. Dependent Claims 7, 20, 33, 47

[7/33] “The cable TV device of claim [1/27], wherein: the DFE comprises a plurality of digital demodulators, and each digital demodulator, of the plurality of digital demodulators, is operable to demodulate a desired channel, of the plurality of desired channels.”

165. [20/47] “The cable TV device of claim [14/41], wherein: each digital down converter comprises a digital demodulator operable to demodulate a desired channel, of the plurality of desired channels, to provide a demodulated channel as the digital channel output.” It is my opinion that Zhang discloses “[t]he cable TV device of claim [1/27], wherein: the DFE comprises a plurality of digital demodulators, and each digital demodulator, of the plurality of digital demodulators, is operable to demodulate a desired channel, of the plurality of desired channels,” as recited in claims 7/33, and “[t]he cable TV device of claim [14/41], wherein: each digital down converter comprises a digital demodulator operable to demodulate a desired channel, of the plurality of desired channels, to provide a demodulated channel as the digital channel output,” as recited in claims 20/47.

166. The composite figure below illustrates Zhang's Figure 3 embodiment 300 of Demultiplexer 230 within Zhang's system illustrated in Figure 2. Zhang discloses a plurality of digital demodulators 250(1)-250(m) (orange), which are part of the same digital circuitry, for example on the same chip, as Demultiplexer 230/300 and Digital Selector 240, which are cited for the claimed "DFE" in independent claims 1 and 27 from which claims 7 and 33 respectively depend. Ex. 1013, [0005], [0011], [0029]-[0031], [0038]-[0039], [0044]-[0047]; *see* Sections 9.2.1.c, 9.2.3.

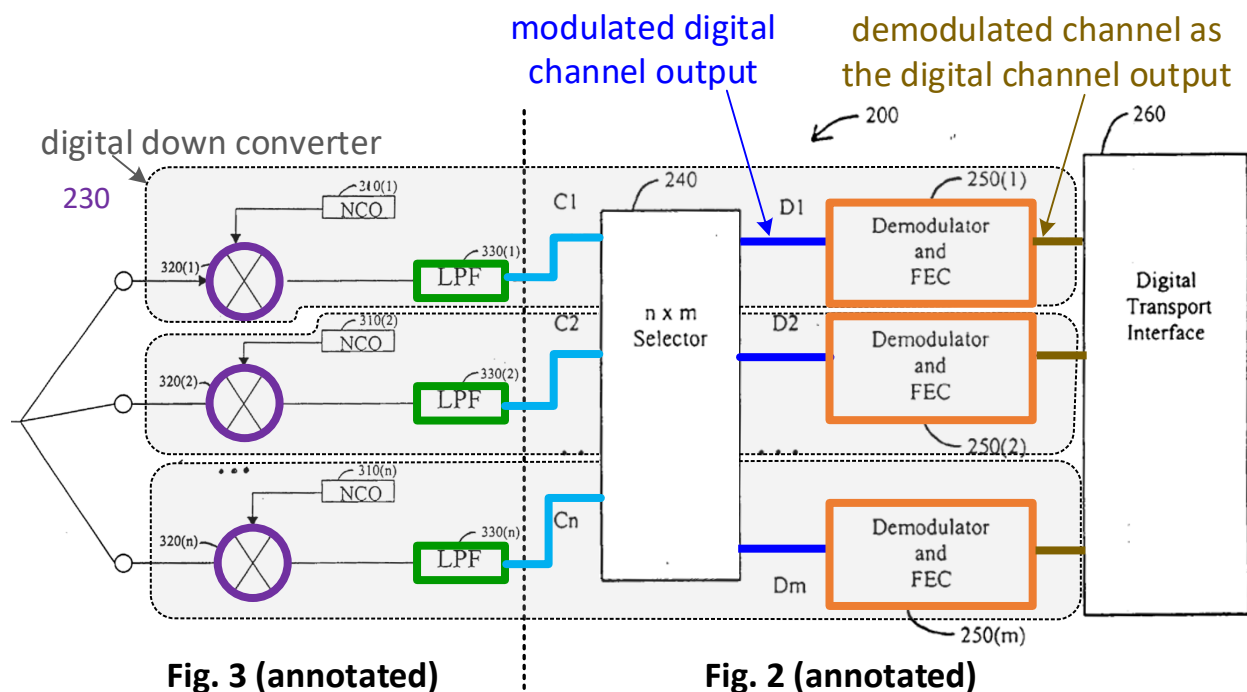


Ex. 1013, Fig. 2 (annotated)

167. Digital Selector 240 receives modulated desired channels C_1 - C_n (light blue) from the filters 330 (green) and provides those channels (dark blue) to demodulators 250 (orange), which each demodulate one of the desired channels C_1 -

C_n (received via D_1 - D_m) and which is outputted as demodulated channels (**brown**).
Ex. 1013, [0028]-[0032]. As such, Zhang anticipates (ground A) and renders obvious (groundB) claims 7 and 33.

168. Zhang's Digital Channel Demultiplexer 230 is also cited for the claimed "plurality of digital down converters" in independent claims 14 and 41, from which claims 20 and 47 depend. Claims 20/47 differ from claims 7/33 in that they recite "each digital down converter comprises a digital demodulator," thus possibly requiring a one for one pairing of digital down converter to digital demodulator. This feature is also disclosed by Zhang as shown below.



Ex. 1013, Figs. 2-3, 5 (annotated)

169. Each digital down converter includes a complex multiplier 320 (purple), filter 330 (green), and demodulator 250 (orange), with Digital Selector 240 providing for a plurality of digital down converters (e.g., as recited in Element [14D]) modulated digital channel outputs (dark blue) to demodulators 250 (orange), which then output demodulated digital channel outputs (brown). Ex. 1013, [0028]-[0032]. Thus, Zhang discloses that “each digital down converter comprises a digital demodulator operable to demodulate a desired channel ... to provide a demodulated channel as the digital channel output.” As such, Zhang anticipates and renders obvious claims 20 and 47.

170. Claims 7 and 20 require (as recited in base claims 1 and 14) that each desired channel/digital channel output is provided “via a serial interface.” Just as described in the ’866 patent, Zhang’s Digital Selector 240 (specifically, selector 510 and data bus 520 in Fig. 5 within Digital Selector 240) provide the desired channels/digital channel outputs in their modulated form via a serial interface to demodulators 250. *See* Sections 9.2.1.c, 9.2.2.c; Ex. 1001, 7:10-14. To the extent claim 7 and 20 require a serial interface to be at the output of the demodulators (or at any other point in the DFE and digital down converters as shown below), such an interface was notoriously well-known, and implementing Zhang’s DFE and plurality of digital down converters with a serial interface at the output of the demodulators would have been obvious in light of a POSITA’s general knowledge, creativity, and

common sense. *See*, e.g., Ex. 1014, 30:31-42, 31:15-22; Ex. 1015 at 5-6; Ex. 1016 at 23, 31-37, 79-80 (Figure 6-25); Ex. 1017 at 354-355. As the '866 patent concedes, outputting a digital data stream via serial interface was “commonly known.” Ex. 1001, 6:55-58.

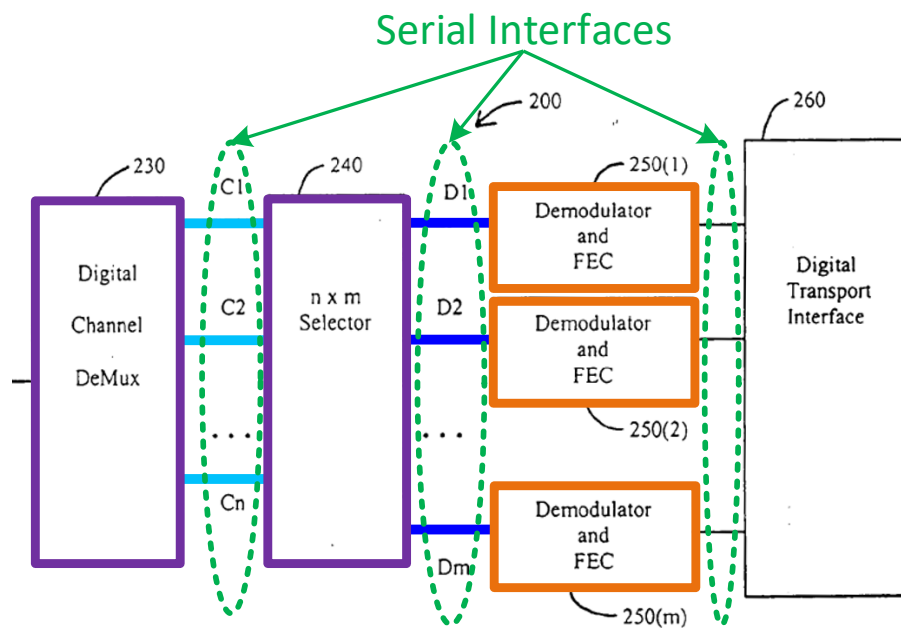


Fig. 2

Ex. 1013, Fig. 2 (annotated)

171. For example, as explained above with respect to Elements [1C] and [14D], CMOS digital circuits (the technology used in Zhang) transmit data as binary units (referred to as “bits”) either in parallel, i.e., over multiple separate wires, one wire for each bit, or over a serial interface, i.e., one bit at a time as sequential pulses over a single wire, according to a fixed sequence. Ex. 1016 at 23, 31-37, 80 (Figure 6-25); Ex. 1015 at 5-6; *see* Sections 9.2.1.c, 9.2.2.c.

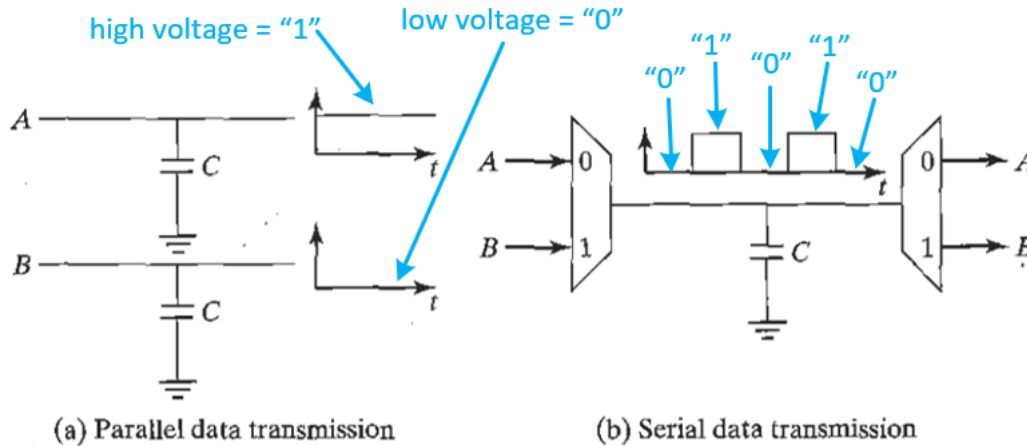


Figure 6-25 Parallel versus time-multiplexed data busses.

Ex. 1016 at 80 (Figure 6-25) (annotated)

172. Thus, it is my opinion that a POSITA implementing the Zhang circuit in CMOS would have been aware of and fully able to implement a serial interface between any of Zhang's digital circuit blocks as shown below, since it was obvious to try as a typical and predictable choice. Ex. 1014, 30:31-42, 31:15-22; Ex. 1015 at 5-6; Ex. 1016 at 79-80; Ex. 1017 at 354-355. For the same reasons, it is my opinion that implementing a serial interface was well within the POSITA's skillset, and thus, it is my opinion that a POSITA implementing a serial interface would have had a high expectation of success leading to a predictable result. Thus, Zhang renders obvious (ground B) claims 20 and 47.

9.2.11. Dependent Claims 3, 4, 16, 17, 29, 30, 43, 44

[3/29] “The cable TV device of claim [1/27], wherein: the DFE comprises a plurality of mixers, and each mixer, of the plurality of mixers, is operable to generate a corresponding complex signal comprising an in-phase (I) component and a quadrature (Q) component.”

[16/43] “The cable TV device of claim [14/41], wherein: each digital down converter comprises a digital mixer operable to generate a corresponding complex signal comprising an in-phase (I) component and a quadrature (Q) component.”

[4/17/30/44] “The cable TV device of claim [3/16/29/43], wherein: the I and Q components of each corresponding complex signal are at baseband.”

173. It is my opinion that Zhang anticipates and renders obvious “[t]he cable TV device of claim [1/27], wherein: the DFE comprises a plurality of mixers, and each mixer, of the plurality of mixers, is operable to generate a corresponding complex signal comprising an in-phase (I) component and a quadrature (Q) component,” as recited in claims 3/29, “[t]he cable TV device of claim [14/41], wherein: each digital down converter comprises a digital mixer operable to generate a corresponding complex signal comprising an in-phase (I) component and a quadrature (Q) component,” as recited in claim 16/43, and “[t]he cable TV device of claim [3/16/29/43], wherein: the I and Q components of each corresponding complex signal are at baseband,” as recited in claims 4/17/30/44.

174. Zhang’s Digital Channel Demultiplexer 230 includes multiple paths, each including a “complex multiplier” 320 (purple) that downconverts a digital

channel within the digital RF signal to baseband, and a filter 330 (**green**) that isolates the digital channel by filtering out all other channels. Ex. 1013, Figs. 2-3, [0012], [0030]-[0034], claims 34, 36-37.

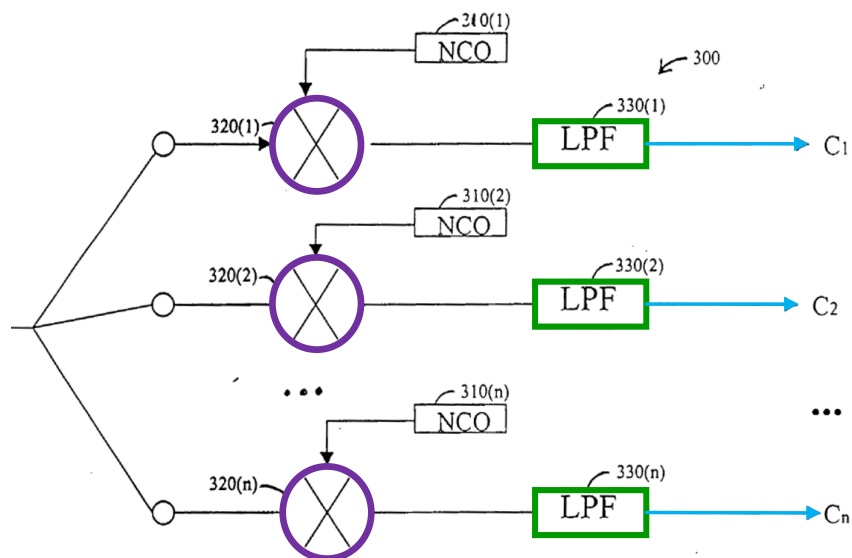


Fig. 3

Ex. 1013, Fig . 3

175. It is my opinion that a POSITA would have understood that “multiplier” (as used in Zhang) and “mixer” are interchangeable names for the same device that shifts the frequency of a modulated signal by multiplying it by another sinusoidal signal having a frequency equal to the amount of the shift. Ex. 1013, [0032]; Ex. 1001, 4:62-64 (“mixers 211 and 221 multiplies (mixes) an amplified RF signal 203 with a respective first oscillator frequency”); *compare* Ex. 1001, 6:6-25 (describing four “multipliers” in complex mixer of Figure 3) *with* Ex. 1001, 9:18-60 (describing four “mixers” in complex mixer in Figure 3); *see also* Ex. 1018, Fig. 1, at 132

(“frequency downconversion ... is performed by multiplying (mixing) the signal with a sinusoid”).

176. Further, as I discuss above (*see* Section 8.3.1, ¶¶ 65-67), complex mixers include two or four real mixers to multiply two signals, at least one being a complex value, resulting in an in-phase (I) (real) component and a quadrature (Q) (imaginary) component. Because Zhang’s multipliers are “complex,” a POSITA would have understood that each output at baseband would be a complex signal, i.e., having quadrature (Q) and in-phase (I) components. Ex. 1013, [0012], [0030], [0032]; *see also* Ex. 1018 at 133-134 (“The realization of a multiplier for mixing a real signal with a complex exponential requires two real multipliers, as illustrated in Fig. 2. The real and imaginary parts of the mixer output are called the in-phase (I) and quadrature (Q) components.”) and (“In Fig. 2 the frequency of the complex exponential is chosen to be the same as the center frequency of the passband signal, for comparison with case 2 in Fig. 1. In this case there is no image problem associated with the *complex mixer*.” (emphasis added)).

177. Zhang further discloses that “complex signal are at baseband,” as recited in claims 4/17/30/44/58/72. For example, Zhang describes that Digital Channel Demultiplexer 230 includes numeric controlled oscillators (NCOs) 310(1)-310(n) that provide to the complex multipliers 320(1)-320(n) the target frequencies of channels $C_1 - C_n$, which the complex multipliers then down convert to baseband

(0 Hz), and which low pass filters (LPFs) 330(1)-330(n) isolate by filtering out undesired channels. Ex. 1013, Fig. 3, [0012], [0028], [0031]-[0032] (“the target RF channel is shifted to a baseband, i.e., centered at DC” and “Digital tuner circuit 300 then outputs the separated RF channels C_1 to C_n , each RF channel being centered at baseband.”), [0036], claims 11, 21, 34, 36-37; Section 8.3, *supra*.

178. Thus, Zhang anticipates (ground A) and renders obvious (ground B) claims 3, 4, 16, 17, 29, 30, 43, 44.

9.2.12. Dependent Claims 5, 18, 31, 45

[5/31] “The cable TV device of claim [3/29], wherein: the DFE comprises a plurality of filters, and each filter, of the plurality of filters, is operable to filter the corresponding complex signal comprising a 6 MHz channel.”

[18/45] “The cable TV device of claim [16/43], wherein: each digital down converter comprises a filter operable to select the corresponding complex signal comprising a 6 MHz channel.”

179. It is my opinion that Zhang anticipates and renders obvious “[t]he cable TV device of claim [3/29], wherein: the DFE comprises a plurality of filters, and each filter, of the plurality of filters, is operable to filter the corresponding complex signal comprising a 6 MHz channel,” as recited in claims 5/31, and “[t]he cable TV device of claim [16/43], wherein: each digital down converter comprises a filter operable to select the corresponding complex signal comprising a 6 MHz channel,” as recited in claims 18/45.

180. Zhang discloses filters 330 (**green**) that as described above with respect to claim 3, 16, 29, and 43, filter the complex signal from the complex multiplier to isolate the complex signal of a selected channel at baseband and filter out unwanted channels. Ex. 1013, Fig. 3, [0032]; *see* Section 9.2.11. Zhang also discloses that the channels are 6 MHz. Ex. 1013, [0006] (“carrier frequencies in the UHF band (300 MHz to 3 GHz) may be spaced at 6 MHz intervals.”).

181. Thus, Zhang anticipates (ground A) and renders obvious (ground B) claims 5, 18, 31, and 45.

9.2.13. Dependent Claims 6, 19, 32, 46

[6/32] “The cable TV device of claim [3/29], wherein: the DFE comprises a plurality of digital demodulators, and each digital demodulator, of the plurality of digital demodulators, is operable to demodulate the corresponding complex signal.”

[19/46] “The cable TV device of claim [16/43], wherein: each digital down converter comprises a digital demodulator operable to demodulate the corresponding complex signal to provide a demodulated channel as the digital channel output.

182. It is my opinion that Zhang anticipates and renders obvious “[t]he cable TV device of claim [3/29], wherein: the DFE comprises a plurality of digital demodulators, and each digital demodulator, of the plurality of digital demodulators, is operable to demodulate the corresponding complex signal,” as recited in claims 6/32, and “[t]he cable TV device of claim [16/43], wherein: each digital down converter comprises a digital demodulator operable to demodulate the corresponding

complex signal to provide a demodulated channel as the digital channel output,” as recited in claims 19/46.

183. Claims 6 and 32 recite identical limitations to claims 7 and 33, and claims 19, and 46 recite identical limitations to claims 20 and 47, except that “a desired channel, of the plurality of desired channels” in claims 7, 20, 33, and 47 is replaced with “the corresponding complex signal” in claims 6, 19, 32, and 46.

184. As I discuss above (*see* Section 9.2.10) with respect to claims 7, 20, 33, and 47, Zhang discloses the claimed “demodulating” and “plurality of demodulators” as digital demodulators 250(1)-250(m) (**orange**), each demodulating one of the desired channels received on inputs D_1 - D_m from Digital Selector 240, which receives the desired channels from inputs C_1 - C_n , and outputting the demodulated channels to Digital Transport Interface 260. Ex. 1013, [0005], [0011], [0029]-[0031], [0038]-[0039], [0042]-[0045]. Moreover, as described above with respect to claims 3-4, 16-17, 29-30, and 43-44, a POSITA would have understood that Zhang’s “complex multiplier” outputs a complex signal, which demodulators 250(1)-250(m) (**orange**) would receive. *See* Section 9.2.11; Ex. 1018, pp. 133-134. Thus, Zhang teaches claims 6, 19, 32, and 46.

9.3. Ground C: Zhang-Reisman (Claims 10-12, 23-25, 27, 33, 35-41, 47, 49-55, 61, 63-69, 75, and 77-82)

9.3.1. Independent Claims 27 and 41, and Dependent Claims 29-33, 35-37, 40, 43-47, 49-51, and 54

[27A] “A cable television (TV) device comprising:”

[27B] “a wideband analog-to-digital converter (ADC) configured to digitize a contiguous band of frequencies in an input signal, wherein the contiguous band of frequencies comprises a plurality of desired channels and a plurality of undesired channels; and”

[27C] “a digital frontend (DFE) coupled to the wideband ADC, wherein the DFE is configured to concurrently select and provide each of the plurality of desired channels without providing any of the plurality of undesired channels, and”

[27D] “wherein the cable TV device comprises a digital video recorder (DVR).”

[41A] “A cable TV device comprising:”

[41B] “a wideband analog-to-digital converter (ADC) configured to digitize an input signal, wherein the input signal comprises a plurality of desired channels and a plurality of undesired channels; and”

[41C] “a plurality of digital down converters coupled to the wideband ADC, 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, and”

[41D] “wherein the cable TV device comprises a digital video recorder (DVR).”

185. The elements of claims 27 and 41 appear in the Claims Listing Appendix, labeled as elements [27A]-[27D] and [41A]-[41D], respectively. For the following reasons, it is my opinion that claims 27 and 41 are rendered obvious based on Zhang in view of Reisman (ground C).

186. Elements [27A]-[27C] are identical to Elements [1A]-[1C], except that Element [27C] does not include the Element [1C] limitation “via a serial interface.” Elements [27A]-[27C] are thus taught by Zhang for the same reasons discussed above with respect to Elements [1A]-[1C]. *See* Sections 9.2.1.a-c, *supra*.

187. Elements [41A]-[41C] are identical to Elements [14A]-[14C] and directed to substantially the same subject matter as Elements [1A]-[1C], and Elements [27A]-[27C], and thus are taught by Zhang for the same reasons discussed above with respect to Elements [1A]-[1C], Elements [14A]-[14C], and Elements [27A]-[27C]. *See* Sections 9.2.1.a-c, 9.2.2.a-c, 9.2.3, *supra*.

188. As I discuss above, it is my opinion that Zhang further discloses Element [27D] and [41D] reciting a “DVR.” *See* Sections 9.2.3, 9.2.4, *supra*.

189. To the extent it is argued that Zhang’s PVR is not a “digital video recorder,” it is my opinion that Reisman discloses this feature. Reisman is directed to advanced TV systems that coordinate the viewing of traditional audiovisual content with hypermedia and interactive features. Ex. 1052, Abstract, Fig. 3, [0120]-[0121], [0125]. Reisman teaches that such systems include a set-top box in a cable system, and that the set-top box may include a digital video recorder (DVR). Ex. 1052, [0005], [0043], [0048], [0060], [0073], [0098] (“TV/ITV 130 is understood to commonly include a set-top box”), [0112], [0118], [0191], [0197], [0212], [0281]-[0285], [0296], [0546].

190. It is my opinion that a POSITA would have been motivated to include Reisman's DVR in Zhang's set-top box to provide a more feature-filled and individualized user experience, which in the proposed combination still includes Zhang's wideband front-end receiver components cited for Elements [27A]-[27C] and [41A]-[41C]. For example, Reisman teaches that a DVR, for example integrated with a set-top box, would "better accommodate programs that are not appointment viewing" by allowing programs to be time-shifted and viewed on-demand, enable replay and trick-play (fast forward and reverse), and permit pausing, and other special features when viewing live programming, thus providing a more feature-filled and individualized user experience. Ex. 1052, [0191], [0197], [0212], [0284]-[0285], [0546], [0758]. As such, the modification of Zhang with Reisman would have been nothing more than applying a known technique of integrating a DVR into a set-top box, as taught in Reisman, to a known set-top box with a wideband front-end receiver that was ready for improvement, as taught by Zhang, to yield a predictable result (DVR capabilities added to the STB).

191. It is my opinion that the resultant combination of Zhang and Reisman would have been predictable, and a POSITA would have had a reasonable expectation of success because set-top boxes and DVRs were well-known in cable television systems, and the components (CPUs, memory, connectors, QAM demodulators, MPEG-2 decoders, etc.) making up such systems were well-known

to a POSITA. Ex. 1052, [0072], [0112], [0197] (referring to “common usage” of a DVR in a cable system). Thus, implementing the combination would have been well within the ordinary skillset of a POSITA.

192. Thus, it is my opinion that Zhang-Reisman renders obvious claims 27 and 41. For the same reasons, it is also my opinion that Zhang-Reisman render obvious claims 29-33, 35-37, 40, 43-47, 49-51, and 54, which depend from claims 27 or 41, and which are taught by Zhang as described above. *See* Sections 9.2.5-9.2.13.

9.3.2. Independent Claim 55

[55A] “A cable television (TV) device comprising:”

[55B] “a wideband analog-to-digital converter (ADC) configured to digitize a contiguous band of frequencies in an input signal, wherein the contiguous band of frequencies comprises a plurality of desired channels and a plurality of undesired channels; and”

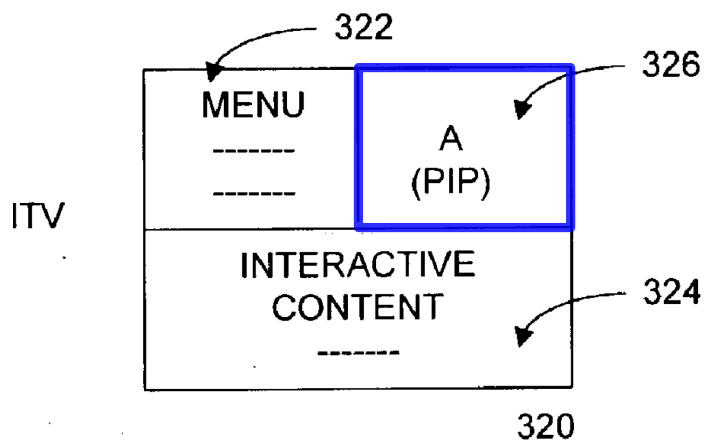
[55C] “a digital frontend (DFE) coupled to the wideband ADC, wherein the DFE is configured to concurrently select and provide each of the plurality of desired channels without providing any of the plurality of undesired channels, and”

[55D] “wherein the cable TV device is operable to configure at least some of the plurality of desired channels as an output for a picture-in-picture display.”

193. The elements of claim 55 appear in the Claims Listing Appendix, labeled as elements [55A]-[55D]. For the following reasons, it is my opinion that claim 55 is rendered obvious by Zhang in view of Reisman (ground C).

194. Elements [55A]-[55C] are identical to Elements [1A]-[1C], except that Element [55C] does not include the Element [1C] limitation “via a serial interface.” Elements [55A]-[55C] are thus taught by Zhang for the same reasons discussed above with respect to Elements [1A]-[1C]. *See* Section 9.2.1.a-c, *supra*. It is my opinion that Reisman discloses Element [55D].

195. As I discuss above with respect to Element [27D], Reisman is directed to advanced TV systems that coordinate the viewing of traditional audiovisual content with hypermedia and interactive features. Ex. 1052, Abstract, Fig. 3, [0120]-[0121], [0125]. Reisman teaches that such systems include a set-top box in a cable system, and that the set-top box may provide a “picture-in-picture display” output for television programming, for example, as shown below (blue). Ex. 1052, Fig. 3 (326), [0073], [0098] (“TV/ITV 130 is understood to commonly include a set-top box”), [0118], [0120]-[0121] (“picture-in-picture (PIP) frame 326” used to present a base program), [0187], [0278], [0291], [0378], [0534], [0537], [0546].



Ex. 1052, Fig. 3 (annotated)

196. A POSITA would have been motivated to include Reisman's "picture-in-picture display" capability in Zhang's set-top box, which includes Zhang's wideband front-end receiver components cited for Elements [55A]-[55C], to allow a user to view different content simultaneously. For example, Reisman teaches with respect to Figure 3 that "picture-in-picture" may be used to display a reduced size base program in PIP window 326 (blue) while simultaneously providing navigation options in a menu window 322 and interactive content in window 324. Ex. 1052, Fig. 3, [0121], [0278]. Another advantageous capability is to enable "multitasking," for example by displaying two resources (e.g., two TV programs), and swapping the resources between full screen and a smaller PIP window. Ex. 1052, [0061], [0063], [0378], [0546]. Thus, it is my opinion that modifying Zhang with Reisman would have been nothing more than the obvious application of a known technique (making a set-top operable to configure and display at least some of the plurality of desired channels as an output for a picture-in-picture display as disclosed in Reisman) to a known device (Zhang's set-top box with a wideband digital front-end receiver) that was ready for improvement to yield a predictable result (PIP capability in the STB).

197. It is my opinion that the resultant combination of Zhang and Reisman would have been predictable, and a POSITA would have had a reasonable expectation of success because set-top boxes with PIP capability were well-known in cable television systems, and the components (CPUs, software, memory,

connectors, QAM demodulators, MPEG-2 decoders, A/V and RF inputs, etc.) making up such systems were well-known to a POSITA, and assembling and programming such components was within the skillset of a POSITA. Ex. 1052, [0112], [0121] (referring to Fig. 3 display with PIP as “typical” from “common ITV system”), [0534]. Moreover, Reisman’s PIP capability and Zhang’s digital front-end receiver provide complimentary features, because as discussed above with respect Element [1C], Zhang’s receiver selects and provides multiple desired channels concurrently to multiple demodulators for simultaneous decoding, and Reisman’s PIP functionality requires and displays two decoded programs simultaneously. Ex. 1052, [0378], [0534]; Ex. 1013, [0005], [0045], *see also Id.*, [0011], [0029]-[0031], [0038]-[0039], [0042], [0044]. Thus, adding PIP functionality to Zhang’s set-top box would have been a straight forward engineering exercise well within the ordinary skillset of a POSITA.

198. As such, it is my opinion that claim 55 is rendered obvious based on Zhang in view of Reisman (ground C).

9.3.3. Independent Claim 69

[69A] “A cable TV device comprising:”

[69B] “a wideband analog-to-digital converter (ADC) configured to digitize an input signal, wherein the input signal comprises a plurality of desired channels and a plurality of undesired channels; and”

[69C] “a plurality of digital down converters coupled to the wideband ADC, wherein each digital down converter, of the plurality of digital down converters, is operable to generate a digital channel output

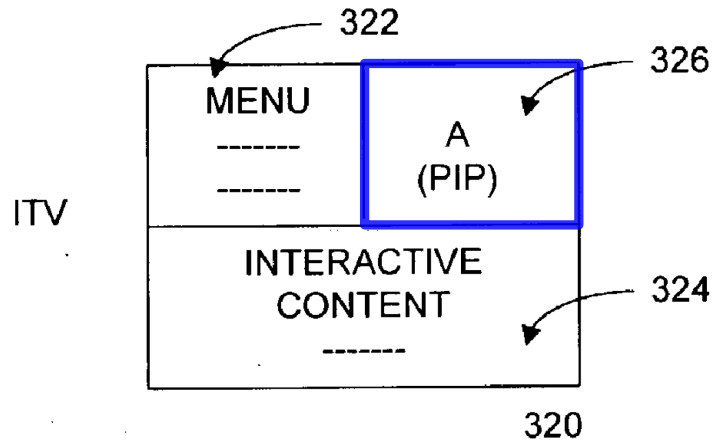
corresponding to each desired channel, of the plurality of desired channels, and”

[69D] “wherein the cable TV device is operable to provide a picture-in-picture display according to the plurality of digital channel outputs.”

199. The elements of claim 69 appear in the Claims Listing Appendix, labeled as elements [69A]-[69D]. For the following reasons, it is my opinion that claim 69 is rendered obvious by Zhang in view of Reisman (ground C).

200. Elements [69A]-[69C] are identical to Elements [14A]-[14C] and directed to substantially the same subject matter as Elements [55A]-[55C], and thus are anticipated and rendered obvious by Zhang for the same reasons discussed above with respect to Elements [1A]-[1C] and Elements [55A]-[55C]. *See* Sections 9.2.1.a-c, 9.3.2.a-c, *supra*.

201. As discussed above with respect to Element [55D], Zhang in view of Reisman teaches Zhang’s set-top box being “operable to configure at least some of the plurality of desired channels as an output for a picture-in-picture display” as disclosed in Reisman. *See* Section 9.3.2, *supra*; Ex. 1052, Fig. 3 (326), [0073], [0098] (“TV/ITV 130 is understood to commonly include a set-top box”), [0118], [0120]-[0121] (“picture-in-picture (PIP) frame 326” used to present a base program), [0187], [0278], [0291], [0378], [0534], [0537], [0546]. An example of the picture-in-picture display provided in Reisman is illustrated in Figure 3 as reproduced below.



Ex. 1052, Fig. 3 (annotated)

202. For the same reasons discussed above, the combination of Zhang in view of Reisman described with respect to Element [55D], also teaches “wherein the cable TV device is operable to provide a picture-in-picture display according to the plurality of digital channel outputs” as recited in Element [69D].

203. Thus, it is my opinion that the combination of Zhang and Reisman (ground C) renders claim 69 obvious.

9.3.4. Dependent Claims 9, 22, 37, 51, 65, and 79

[9/22/37/51/65/79] “The cable TV device of claim [1/14/27/41/55/69], wherein: the plurality of desired channels comprises at least one cable broadcast channel.”

204. It is my opinion that Zhang in view of Reisman teach “[t]he cable TV device of claim [1/14/27/41/55/69], wherein: the plurality of desired channels comprises at least one cable broadcast channel,” as recited in claims 9/22/37/51/65/79.

205. Claims 65 and 79, except for depending from different independent claims, recite the identical limitations as claims 9, 22, 37 and 51. As I have described above, Zhang teaches these limitations. *See* Section 9.2.5. Thus it is my opinion that claims 65 and 79 are rendered obvious by Zhang in view of Reisman for the reasons I discuss above with respect to their base claims 55 and 69, respectively, and for Zhang's additional teaching of a cable broadcast channel.

206. It is my opinion that claims 9, 22, 37, 51, 65, and 79 are also rendered obvious over Zhang in view of Reisman (ground C) based on Reisman additionally disclosing the claimed "cable broadcast channel." As I discuss above with respect to Element [27D], Reisman is directed to advanced TV systems that coordinate the viewing of traditional audiovisual content with hypermedia and interactive features. Ex. 1052, [0120]-[0121], [0125], Fig. 3. *See* Section 9.3.1. Reisman teaches that such systems include a set-top box in a cable system, and that programs may be sent "one-way, such as broadcast," which Reisman describes as "any form of distribution intended to go simultaneously to many recipients (one-to-all, one-to-many), including ... cable and satellite distribution, and the like." Ex. 1052, [0063], [0073], [0086]-[0088], [0090], [0098], Fig. 1.

207. To the extent Zhang's digital wideband receiver integrated in a set-top box is not already configured to receive desired channels that include "at least one cable broadcast channel," it is my opinion that it would have been obvious to modify

Zhang to receive such a channel as taught in Reisman for the benefit of enabling Zhang's set-top box to receive traditional television programs on network and cable channels, from broadcasters like ABC and PBS, and from local broadcasters. Ex. 1052, [0008], [0643], [0645]. It is my opinion that such a modification would have been nothing more than applying a known technique (Reisman's use of a STB to receive cable broadcast channel in a cable network) to a known device (Zhang's STB) ready for improvement (by adding the ability to receive cable broadcasts from various sources, such as ABC, PBS, and local broadcasters) to yield predictable results. Reisman teaches that "[d]igital TV set-top boxes are routinely equipped with facilities to connect to a TV source (typically analog or multiplexed digital QAM)" and "NTSC and QAM demodulators," Ex. 1052, [0112], [0277], that a POSITA would understand is routinely used to receive broadcast channels for viewing on a television, like a live sporting event shown on a network channel like CBS, for example. Further, cable television providers typically sent many broadcast channels spaced 6 MHz apart for such purposes.

208. It is my opinion that the resultant combination of Zhang and Reisman would have been predictable, and a POSITA would have had a reasonable expectation of success, because receiving cable broadcast channels with set-top boxes in cable networks was ubiquitously well-known, and modifying Zhang's STB

to receive Reisman's cable broadcast channels would have been well within capability of a POSITA..

209. Thus, it is my opinion that claims 9, 22, 37, 51, 65, and 79 are rendered obvious over Zhang in view of Reisman (Ground C) for this further reason.

9.3.5. Dependent Claims 10, 23, 38, 52, 66, and 80

[10/23/38/52/66/80] “The cable TV device of claim [1/14/27/41/55/69], wherein: the plurality of desired channels comprises at least one channel delivered via a Data Over Cable Service Interface Specification (DOCSIS) protocol.”

210. It is my opinion that Zhang in view of Reisman discloses “[t]he cable TV device of claim [1/14/27/41/55/69], wherein: the plurality of desired channels comprises at least one channel delivered via a Data Over Cable Service Interface Specification (DOCSIS) protocol,” as recited in claims 10/23/38/52/66/80.

211. As I discuss above with respect to claims 9, 22, 37, 51, 65, and 79, each of Zhang and Reisman teaches a set-top box in a cable system that broadcasts channels, and it would have been obvious to use Zhang's set-top box to receive such channels as taught in Zhang or Reisman to enable a user to watch programs from national and local broadcasters on cable channels. Ex. 1052, [0008], [0063], [0073], [0086]-[0088], [0090], [0098], [0643]-[0645], Fig. 1. Reisman further teaches that transmission protocols in a cable system include “DOCSIS (Data Over Cable Service Interface Specification),” where transmission may be “directed to ... STB [] addresses.” Ex. 1052, [0087]. Reisman further discloses that sourcing base TV or

video and enhancements may be by DOCSIS, in which “IP is used within a TV distribution infrastructure.” Ex. 1052, [0235].

212. It is my opinion that a POSITA would have been motivated to add to Zhang’s set top box the ability to receive a desired channel via DOCSIS as taught in Reisman. Doing so would allow desired channels to be addressed to a specific Zhang STB (as opposed to just receiving broadcast channels), which a POSITA would have recognized would enable enhanced features such as the availability of more video-on-demand or other personalized content. Ex. 1052, [0024], [0063], [0125], [0187], [0189], [0209]. It is my opinion that a POSITA would have further recognized that implementing DOCSIS in Zhang’s set-top boxes would allow for base video and enhancements to be sourced together over the same distribution infrastructure, which would eliminate the need for a separate infrastructure, such as a separate internet connection, to provide enhancements. Such a modification would have simply been the application of a known technique (Reisman’s DOCSIS protocol for the transmission of channels) to a known device (Zhang’s set-top box with the wideband digital front-end receiver) ready for improvement to yield predictable results (the STB receives channels via DOCSIS). Moreover, Zhang already discloses incorporating a DOCSIS return channel, and adding a DOCSIS forward channel as disclosed in Reisman would simply have been a logical design choice to implement

the entire DOCSIS standard. Ex. 1013, [0047] (“For cable services, a wide-band receiver using the invention can incorporate a DOCSIS return channel.”).

213. It is my opinion that the resultant combination of Zhang and Reisman would have been predictable, and a POSITA would have had a reasonable expectation of success, because the DOCSIS protocol was a standard designed for cable systems and set top boxes, and adopted by cable operators at the time. Ex. 1021 at 2-5, Fig. 1-2; Ex. 1033 pp. 27, 211-212. Thus, a POSITA would have been familiar with the standard and accustomed to implementing it in set-top boxes. Thus, modifying Zhang’s set-top box to receive at least one desired channel via the DOCSIS protocol would have been a straight forward engineering exercise well within the ordinary skillset of a POSITA.

214. As such, it is my opinion that claims 10, 23, 38, 52, 66, and 80 are rendered obvious over Zhang in view of Reisman (ground C).

9.3.6. Dependent Claims 11, 24, 67, and 81

[11/24/67/81] “The cable TV device of claim [1/14/55/69], wherein: the cable TV device comprises a digital video recorder (DVR).”

215. Claims 11, 24, 67, and 81 recite the identical limitation as Element [27D]. As I discuss above with respect to Element [27D], Reisman discloses this features, and thus it is my view that these claims are rendered obvious by Zhang in view of Reisman (ground C), for the same reasons discussed with respect to Element [27D]. *See* Section 9.3.1, *supra*.

9.3.7. Dependent Claims 12, 25, 39, 53

[12/39] “The cable TV device of claim [1/27], wherein: the cable TV device is operable to configure at least some of the plurality of desired channels as an output for a picture-in-picture display.”

[25/53] “The cable TV device of claim [14/53], wherein: the cable TV device is operable to provide a picture-in-picture display according to the plurality of digital channel outputs.”

216. It is my opinion that Zhang in view of Reisman disclose “[t]he cable TV device of claim [1/27], wherein: the cable TV device is operable to configure at least some of the plurality of desired channels as an output for a picture-in-picture display,” as recited in claims 12/39, and “[t]he cable TV device of claim [14/53], wherein: the cable TV device is operable to provide a picture-in-picture display according to the plurality of digital channel outputs,” as recited in claim 25/53.

217. Claims 12 and 39 recite the identical limitation as in Element [55D], and claims 25 and 53 recite the identical limitation as in Element [69D], which is substantially the same as Element [55D]. As I discuss above, Reisman discloses these limitations. *See* Sections 9.3.2, 9.3.3, *supra*.

218. In my view, claims 12, 25, 39, and 53 are thus taught by Zhang in view of Reisman (ground C) for the same reasons discussed above with respect to their base claims 1, 14, 27, and 41, respectively, and for Reisman’s additional teaching of PIP as combined with Zhang as described above with respect to Elements [55D] and [69D]. *See* Sections 9.2.1-4 (Base claims 1, 14, 27, 41), 9.3.2 (Element [55D]), 9.3.3 (Element [69D]), *supra*.

9.3.8. Dependent claims 57-61, 63-64, 68, 71-75, 77-78, and 82

219. The limitations of claims 57-61, 63, 64, 68, 71-75, 77, 78, and 82 are identical to those of claims 29-33, 35, 36, 40, 43-47, 49, 50, and 54, respectively. As I have described above, these limitations are taught by Zhang. *See* Sections 9.2.7-13, *supra*.

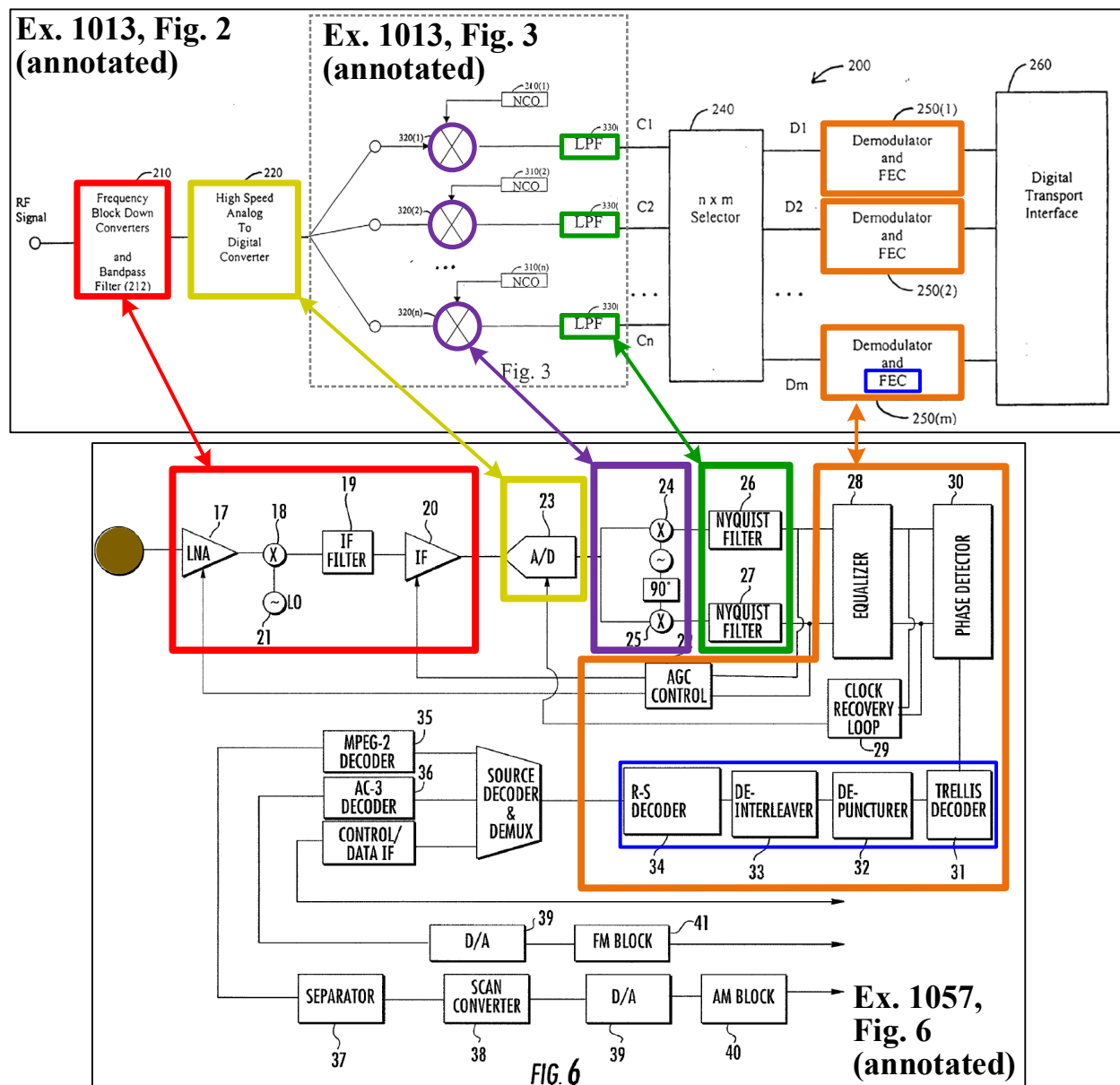
220. It is my opinion that claims 57-61, 63, 64, 68, 71-75, 77, 78, and 82 are obvious over Zhang in view of Reisman for the same reasons discussed above with respect to their respective base claims 55 and 69, and because Zhang additionally teaches the limitations of each of these claims.

9.4. Ground D: Zhang-Jackson (Claims 2-6, 15-19, 28-32, and 42-46), Ground E: Zhang-Reisman-Jackson (Claims 28-32, 42-46, 56-60 and 70-74)

221. In the following, I provide an element-by-element analysis showing how Zhang in view of Jackson render obvious claims 2-6, 15-19, 28-32, and 42-46 obvious (ground D) and how Zhang in view of Reisman and Jackson render obvious claims 28-32, 42-46, 56-60 and 70-74 (ground E). To help illustrate how the disclosures of these references map to the claim limitations, I have color coded some of my remarks and some figures in the noted art below.

222. As shown below, Jackson discloses in Figure 6 a receiver system for demodulating digitally encoded cable (TV) channels, which has the same architecture to and performs the same functions as Zhang's multi-channel

demodulator system in Figure 2 (reproduced below). Ex. 1057, Fig. 6, [0025]-[0027]; Ex. 1013, Fig. 2, [0023], [0045].



223. Both systems have similar RF tuners (**red**) that downconvert an analog RF signal received from a cable system to a lower frequency, an analog to digital converter (**gold**) that converts the downconverted analog RF signal to a digital RF signal, a complex mixer/multiplier (**purple**) that downconverts a digital channel

within the digital RF signal to baseband, a filter (**green**) that isolates the digital channel at baseband and filters out all other channels, and a demodulator (**orange**) that demodulates the channel with the use of functional blocks like clock/carrier recovery and forward error correction (**dark blue**). Ex. 1013, Figs. 2-3, [0025]-[0031], [0045]; Ex. 1057, Fig. 6, [0025].

224. It is my opinion that Jackson discloses additional details that teach the elements recited in claims 2-6, 15-19, 28-32, 42-46, 56-60, and 70-74, which a POSITA would have found advantageous for implementing the Zhang (grounds A and B) and Zhang-Reisman (ground C) receivers for the reasons discussed below. The Jackson features for modifying Zhang as described below are independent of the Reisman features (e.g., the addition of a DVR , picture-in-picture) added to Zhang for independent claims 25, 38, 51, and 64, and thus a POSITA would have added Jackson's teachings to Zhang-Reisman or Zhang with the same motivation and expectation of success.

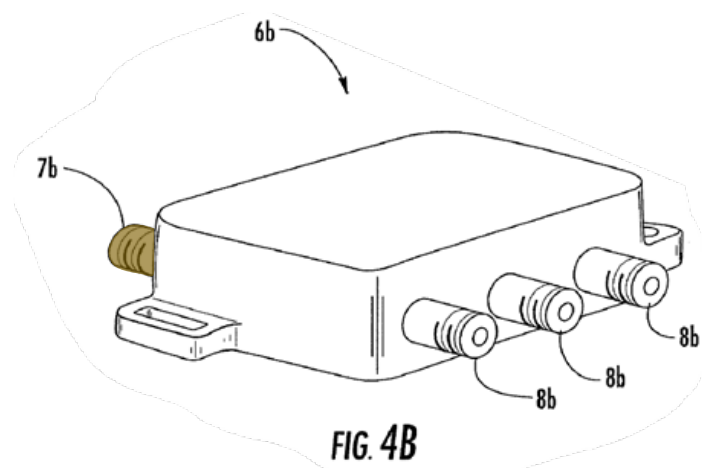
9.4.1. Dependent Claims 2, 15, 28, 42, 56, and 70

[2/15/28/42/56/70] “The cable TV device of claim [1/14/27/41/55/69], wherein: the cable TV device comprises a cable network connector, and the input signal is operably communicated from the cable network connector to the wideband ADC via at least one of an analog amplifier and an analog filter.”

225. It is my opinion that Zhang in view of Jackson disclose “[t]he cable TV device of claim [1/14/27/41/55/69], wherein: the cable TV device comprises a cable

network connector, and the input signal is operably communicated from the cable network connector to the wideband ADC via at least one of an analog amplifier and an analog filter” as recited in claims 2/15/28/42/56/70.

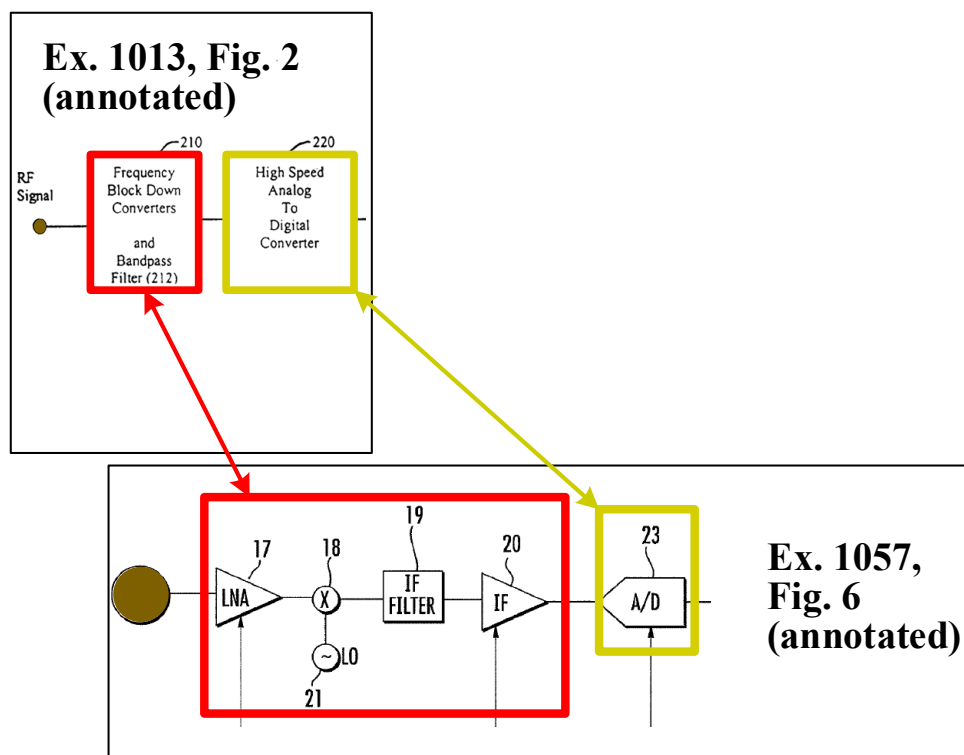
226. Both of Zhang’s and Jackson’s systems receive a RF input signal at a connection (**brown**) to a cable system, which a POSITA would have understood to be the claimed “cable network connector.” Ex. 1013, Fig. 2, [0023]; Ex. 1057, Fig. 6, [0006], [0023], [0025]. As shown below, Jackson additionally discloses an input connector 7b for connecting to the cable system, which a POSITA would also have understood to be a “cable network connector.” Ex. 1057, Fig. 4B, [0023], claims 1, 8, 12.



Ex. 1057, Fig. 4B (annotated)

227. From this input, the RF signal is communicated in Zhang and Jackson via an RF tuner (**red**) to the ADC (**gold**) as shown below, and the same would occur in Zhang-Jackson and Zhang-Reisman-Jackson. Both Zhang and Jackson disclose passing the signal through an analog bandpass filter (each a claimed “analog filter”).

Ex. 1013, [0026], Fig. 2 (“Bandpass Filter 212”); Ex. 1057, [0027], Fig. 7. Jackson additionally discloses that the path through the tuner may include an analog IF filter 19 (also a claimed “analog filter”) and analog amplifiers (e.g., low noise amplifier 17, IF amplifier 20) (each a claimed “analog amplifier”). Ex. 1057, [0025], [0027]. For example, Jackson discloses that “[t]he RF tuner comprises low noise amplifier 17 to boost the power of the received signals, mixer 18 that mixes the received signals with local oscillator 21 to downconvert the carrier frequency of the received signals from RF to IF, IF filter 19, and IF amplifier 20.” Ex. 1057, [0025]; Section 8.3.1, *supra*.



228. It is my opinion that a POSITA would have been motivated to implement Zhang’s RF input (**brown**) using Jackson’s input connector (**brown**) as

a way for an installer to easily couple the receiver to the cable system. Ex. 1057, [0023], Fig. 4B (connector 7*b*), claims 7-8. As such, the combination of Zhang and Jackson would have been nothing more than a simple substitution of one known element (Jackson's input connector) for another (Zhang's RF input) to obtain a predictable result. It is my opinion that this combination of Zhang and Jackson is predictable, and a POSITA would have had a reasonable expectation of success, because Jackson's connector was well known to a POSITA and common in conventional CATV systems that utilize coaxial cable to connect to receiver systems, such as the set-top boxes disclosed in Jackson and Zhang. Ex. 1057, [0002]-[0004], [0019]-[0020], [0023], claim 8; Ex. 1013, [0005], [0015], [0045], [0048].

229. Additionally, Zhang discloses that its Frequency Block Down Converter 210 comprises a Bandpass Filter 212, but it is silent regarding other aspects of Converter 210's implementation. It is my opinion that a POSITA would have been motivated implement Zhang's converter 210 (**red**) with Jackson's analog amplifiers and analog filters to Zhang's Frequency Block Down Converter 210 (**red**). Ex. 1057, [0025], [0027]. Jackson teaches that the amplifiers boost the power and enable automatic gain control of the RF input signal, which a POSITA would have understood as beneficial for obtaining the highest possible performance. Ex. 1057, [0025]; Ex. 1034 pp. 40-41. A POSITA would have further understood that Jackson's analog filters suppress unwanted signals so that they do not interfere with

the desired channels that are intended to be received. Ex. 1057, [0025]; Ex. 1034, pp 40-41. Thus, the combination of Zhang and Jackson would have been nothing more than the use of a known technique (using Jackson's analog amplifiers and filters for amplification, gain control and filtering of unwanted signals in a front end down converter) to improve a similar device (Zhang's Frequency Block Down Converter 210 that performs the same function as Jackson's front end tuner) in a similar way.

230. It is my opinion that this combination of Zhang and Jackson is predictable, and a POSITA would have had a reasonable expectation of success, because Jackson's receiver used components that were common and well known to a POSITA, because the basic architecture of Jackson's receiver matches Zhang's receiver, and because these components from Jackson would perform the same functions as they perform in Jackson.

231. Thus, it is my opinion that Zhang in view of Jackson (ground D) render obvious claims 2, 15, 28, and 42, and Zhang in view of Reisman and Jackson (ground E) render obvious claims 56, and 70.

9.4.2. Dependent Claims 3, 4, 16, 17, 29, 30, 43, 44, 57, 58, 71, and 72

[3/29/57] “The cable TV device of claim [1/27/55], wherein: the DFE comprises a plurality of mixers, and each mixer, of the plurality of mixers, is operable to generate a corresponding complex signal comprising an in-phase (I) component and a quadrature (Q) component.”

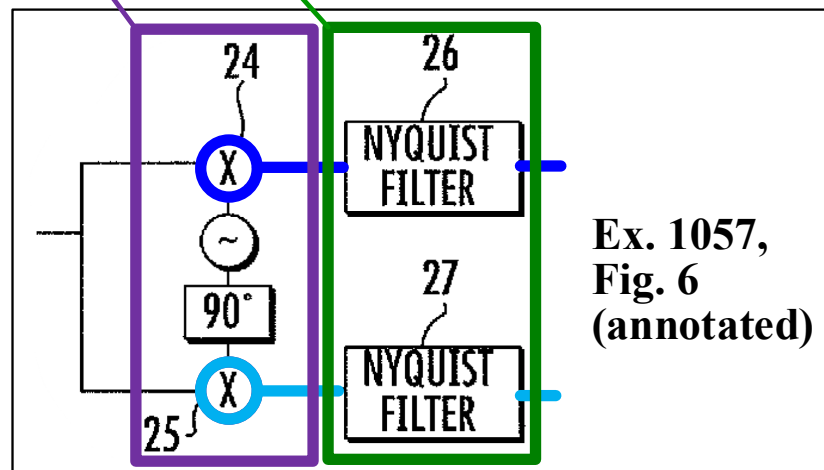
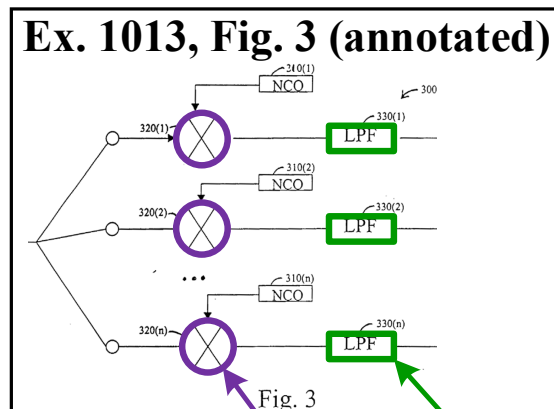
[16/43/71] “The cable TV device of claim [14/41/69], wherein: each digital down converter comprises a digital mixer operable to generate a corresponding complex signal comprising an in-phase (I) component and a quadrature (Q) component.”

[4/17/30/44/58/72] “The cable TV device of claim [3/16/29/43/57/71], wherein: the I and Q components of each corresponding complex signal are at baseband.”

232. As described above (Section 9.2.11), Zhang, discloses complex multipliers 320(1)-320(n) and filters 330(1)-330(n) that down convert and output I and Q components of the desired channels at baseband, and thus Zhang anticipates and renders obvious claims 3, 4, 16, 17, 29, 30, 43, and 44, and Zhang-Reisman renders obvious claims, 57, 58, 71, and 72. *See* Sections VII.11, VII.B.8.

233. To the extent Zhang’s complex mixers do not teach I and Q outputs, it is my opinion that these are disclosed by Jackson as shown below. Jackson expressly discloses the structure of a complex mixer, which includes two real multipliers 24 and 25 (referred to as a “QAM demodulator”) that generate quadrature (Q) (**dark blue**) and in-phase (I) (**light blue**) components, respectively. Ex. 1057, [0025] (“The QAM demodulator includes multipliers 24 and 25 that multiply the digital data with the carrier and with the carrier delayed 90°, respectively, followed by Nyquist filters 26 and 27 to recover the in-phase and quadrature components.”); Ex.

1018, pp. 133-134. As I discuss above (*see* Section 8.3.1, ¶¶ 65-67), complex mixers include two or four real mixers to multiply two signals, at least one being a complex value, resulting in an in-phase (I) (real) component and a quadrature (Q) (imaginary) component.



234. Zhang further discloses that “complex signal are at baseband,” as recited in claim 4/17/30/44/58/72. For example, Zhang describes that Digital Channel Demultiplexer 230 includes numeric controlled oscillators (NCOs) 310(1)-310(n) that provide to the complex multipliers 320(1)-320(n) the right frequencies for desired channels $C_1 - C_n$, which the complex multipliers then down convert to

baseband (0 Hz), and which low pass filters (LPFs) 330(1)-330(n) isolate by filtering out undesired channels. Ex. 1013, Fig. 3, [0012], [0028], [0031]-[0032] (“the target RF channel is shifted to a baseband, i.e., centered at DC” and “Digital tuner circuit 300 then outputs the separated RF channels C_1 to C_n , each RF channel being centered at baseband.”), [0036], claims 11, 21, 34, 36-37; Section 8.3, *supra*.

235. It is my opinion that a POSITA reading Zhang’s express teachings of a “complex multiplier” would have found it obvious to turn to a known implementation, such as taught by Jackson (e.g., as depicted in Jackson’s Figure 6), to implement this device. Ex. 1013, Figs. 2-3, [0025]-[0031], [0045]. This would have been nothing more than a simple substitution of one known element (Jackson’s multipliers 24 and 25 that generate I and Q components) for another (Zhang’s complex multiplier that outputs a baseband signal) to obtain a predictable result (the mixer generates I and Q signals of desired channels at baseband, allowing the filtering of undesired channels).

236. It is my opinion that a POSITA would have further been motivated to implement Zhang’s complex multipliers (purple) as shown in the comparative figure above with Jackson’s complex mixers to output I and Q components of Zhang’s baseband selected channels, because doing so would enable Zhang’s system to demodulate QAM modulated signals. Ex. 1057, [0025]. A POSITA would have further recognized the use of I and Q components as taught by Jackson would enable

Zhang's receiver to more effectively address image band problems, which is a known issue of mixers superimposing images of undesired signals over down-converted desired signals. Ex. 1018 at 133. Thus, the modification of Zhang with Jackson would also been the use of a known technique (using Jackson's two real mixers 24 and 25 to implement a complex mixer with I and Q outputs) to improve a similar device (Zhang's complex multiplier) in the same way as taught in Jackson.

237. This combination would have been predictable because Jackson's receiver used basic and typical components of a complex mixer that were well known to a POSITA, and because its implementation in Zhang was well within the POSITA's skillset, leading to an expectation of success. *See, e.g.*, Ex. 1025, pp. 279-280; Ex. 1034, pp. 65-76; Ex. 1018, pp. 133-134, Fig. 3. Further, a POSITA would have had a reasonable expectation of success in combining Zhang and Jackson, because the implementation of Jackson's receiver was taught in basic textbooks and well within a POSITA's skillset. *See, e.g.*, Ex. 1025 at 279-280; Ex. 1034 at 65-76; Ex. 1018 at 134-137, Figs. 1-3, 6-7, 9-10.

238. Thus, Zhang in view of Jackson (ground D) render obvious claims 3, 4, 16, 17, 29, 30, 43, and 44, and Zhang in view of Reisman and Jackson (ground E) render obvious claims 57, 58, 71, and 72.

9.4.3. Dependent Claims 5, 18, 31, 45, 59, and 73

[5/31/59] “The cable TV device of claim [3/29/57], wherein: the DFE comprises a plurality of filters, and each filter, of the plurality of filters, is operable to filter the corresponding complex signal comprising a 6 MHz channel.”

[18/45/73] “The cable TV device of claim [16/43/71], wherein: each digital down converter comprises a filter operable to select the corresponding complex signal comprising a 6 MHz channel.”

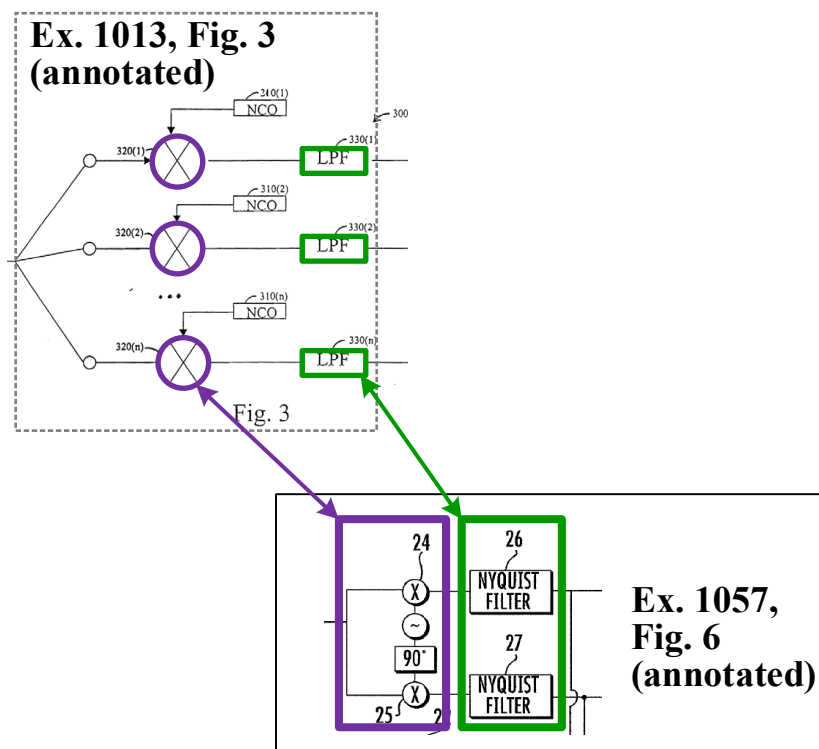
239. As I describe above, Zhang, discloses filters 330(1)-330(n) that select 6MHz complex signals from the complex multiplier. *See* Sections 9.2.12, 9.3.8.

240. To the extent Zhang’s filters do not teach filtering 6MHz complex signals, it is my opinion that Jackson does, and thus Zhang in view of Jackson (ground D) render obvious “[t]he cable TV device of claim [3/29], wherein: the DFE comprises a plurality of filters, and each filter, of the plurality of filters, is operable to filter the corresponding complex signal comprising a 6 MHz channel,” as recited in claim 5/31, and “[t]he cable TV device of claim [16/43], wherein: each digital down converter comprises a filter operable to select the corresponding complex signal comprising a 6 MHz channel,” as recited in claim 18/45.

241. It is also my opinion that each of Zhang in view of Reisman and Jackson (ground E) render obvious “[t]he cable TV device of claim 57, wherein: the DFE comprises a plurality of filters, and each filter, of the plurality of filters, is operable to filter the corresponding complex signal comprising a 6 MHz channel,” as recited in claim 59, and “[t]he cable TV device of claim 71, wherein: each digital down

converter comprises a filter operable to select the corresponding complex signal comprising a 6 MHz channel,” as recited in claim 73.

242. Jackson discloses Nyquist filters 26/27 (**green**) that filter the complex signal output from the complex mixer to isolate the complex signal of a selected channel at baseband and filter out unwanted channels. Ex. 1057, Fig. 6, [0025]. Jackson also discloses that the channels are 6 MHz. Ex. 1057, Fig. 6, [0002] (“Multiple standard digital cable broadcast channels can be transmitted in one such 6 MHz frequency band.”), [0026].



243. A POSITA would have been motivated to implement Zhang’s filters 330 (**green**) with Jackson’s filters 26/27 to isolate the I and Q components of

Zhang's 6 MHz selected channels. Ex. 1013, [0006], [0012], [0025], [0030]-[0032]; Ex. 1057, [0002], [0025], Fig. 3.

244. As illustrated above, these modifications simply involve the one-to-one replacement of Zhang's components with Jackson's components that perform the exact same function, and thus, it is my opinion that the combination of Zhang and Jackson would have been nothing more than a simple substitution of one known element (Jackson's filters) for another (Zhang's filters) to obtain a predictable result (filtering I and Q components of a complex signal). Specifically, these modifications simply involve replacement of Zhang's filters 330 (**green**) with Jackson's filters 26/27. The combination is predictable because Jackson's receiver used components that were common and well known to a POSITA, and because their implementation was well within the skillset of the POSITA. *See, e.g.,* Ex. 1025 pp. 279-280; Ex. 1034, pp. 65-76. Further, a POSITA would have had a reasonable expectation of success in combining Zhang and Jackson, because the implementation of Jackson's receiver was taught in basic textbooks and well within a POSITA's skillset. *See e.g.,* Ex. 1025 pp. 279-280; Ex. 1034 pp. 65-76; Ex. 1018 pp. 134-139, Figs. 1-3, 6-7, 9-10.

245. Thus, it is my opinion that Zhang in view of Jackson (ground D) render obvious claims 5, 18, 31, and 45, and Zhang in view of Reisman and Jackson (ground E) render obvious claims 59 and 73.

9.4.4. Dependent Claims 6, 19, 32, 46, 60, and 74

[6/32/60] “The cable TV device of claim [3/29/57], wherein: the DFE comprises a plurality of digital demodulators, and each digital demodulator, of the plurality of digital demodulators, is operable to demodulate the corresponding complex signal.”

[19/46/74] “The cable TV device of claim [16/43/71], wherein: each digital down converter comprises a digital demodulator operable to demodulate the corresponding complex signal to provide a demodulated channel as the digital channel output.”

246. As described above (Section 9.2.13), Zhang anticipates and renders obvious claims 6, 19, 32, and 46 (grounds A and B), and Zhang-Reisman renders obvious claims 60 and 74 (ground C). *See* Sections 9.2.13, VII.3.8.

247. To the extent Zhang’s does not disclose demodulators that demodulate a complex signal, Jackson does. Jackson teaches an analogous demodulator (**orange**) that demodulates the complex signal separated into I and Q components to provide a demodulated channel as an MPEG-2 transport stream. Ex. 1057, [0025].

248. A POSITA reading Zhang’s express teachings of a “demodulator” that received the output of a complex multiplier would have found it obvious and been motivated to turn to a known implementation, such as taught by Jackson (e.g., as depicted in Jackson’s Figure 6), to implement this device, because Jackson expressly shows its demodulator receiving and demodulating I and Q components of a complex signal to recover demodulated digital data. Ex. 1013, Figs. 2-3, [0028]-[0031], [0038]-[0039], [0047], claims 2, 4-5; Ex. 1057, [0024]-[0025], Figs. 5-6. These modifications simply involve the implementation of Zhang’s demodulator

with Jackson's demodulator that performs the exact same function, and thus, the combination of Zhang and Jackson would have been nothing more than a simple substitution of one known element (Jackson's demodulator) for another (Zhang's demodulator) to obtain a predictable result.

249. The combination is predictable because Jackson's demodulator used components that were common and well known to a POSITA, and because their implementation was within the skillset of the POSITA and requires little change to Zhang's architecture. *See e.g.*, Ex. 1025 at 279-280; Ex. 1034 at 65-75. Further, a POSITA would have had a reasonable expectation of success in combining Zhang and Jackson, because the implementation of Jackson's receiver was taught in basic textbooks and well within a POSITA's skillset. *See e.g.*, Ex. 1025, pp. 279-280; Ex. 1034, pp. 65-75; Ex. 1018, pp. 134-139, Figs. 1-3, 6, 7, 9, 10.

250. Thus, it is my opinion that Zhang in view of Jackson (ground D) render obvious claims 6, 19, 32, and 46, and Zhang in view of Reisman and Jackson (ground E) render obvious claims 60 and 74.

9.5. Ground F: Zhang-Pandey (Claims 1, 3-9, 11, 13, 14, 16-22, 24, 26, 34-36, and 48-50), and Ground G: Zhang-Reisman-Pandey (Claims 9-12, 22-25, 34-36, 48-50, 62-64, and 76-78)

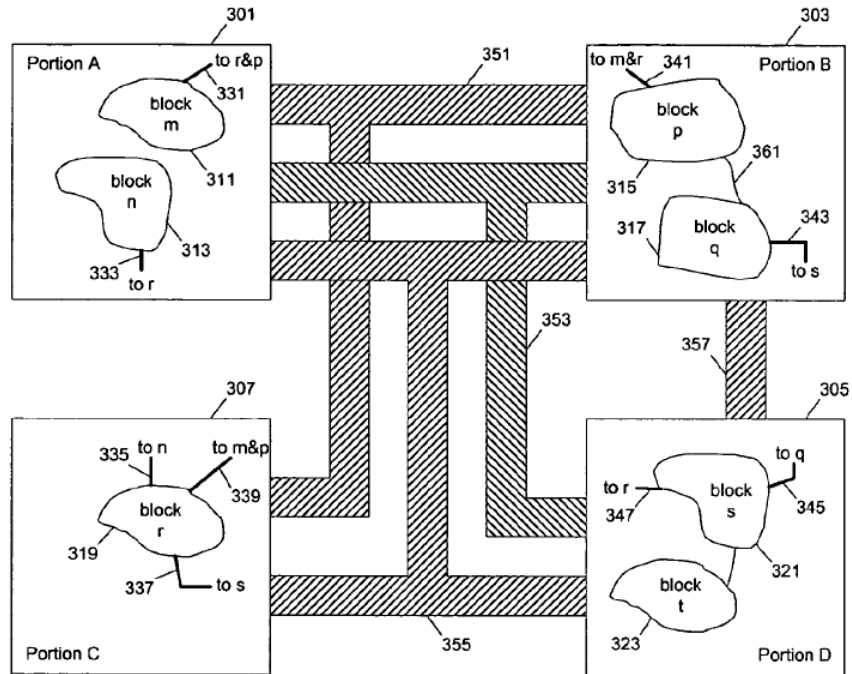
251. It is my opinion that Zhang in view of Pandey (ground F) render obvious claims 1, 3-9, 11, 13, 14, 16-22, 24, 26, 34-36, and 48-50, and Zhang in

view of Reisman and Pandey (ground G) render obvious claims 10-12, 23-25, 34-36, 48-50, 62-64, and 76-78.

9.5.1. Claims 1, 3-7, 9-14, 16-20, 22-26, 35-36, 49-50, 63-64, and 77-78

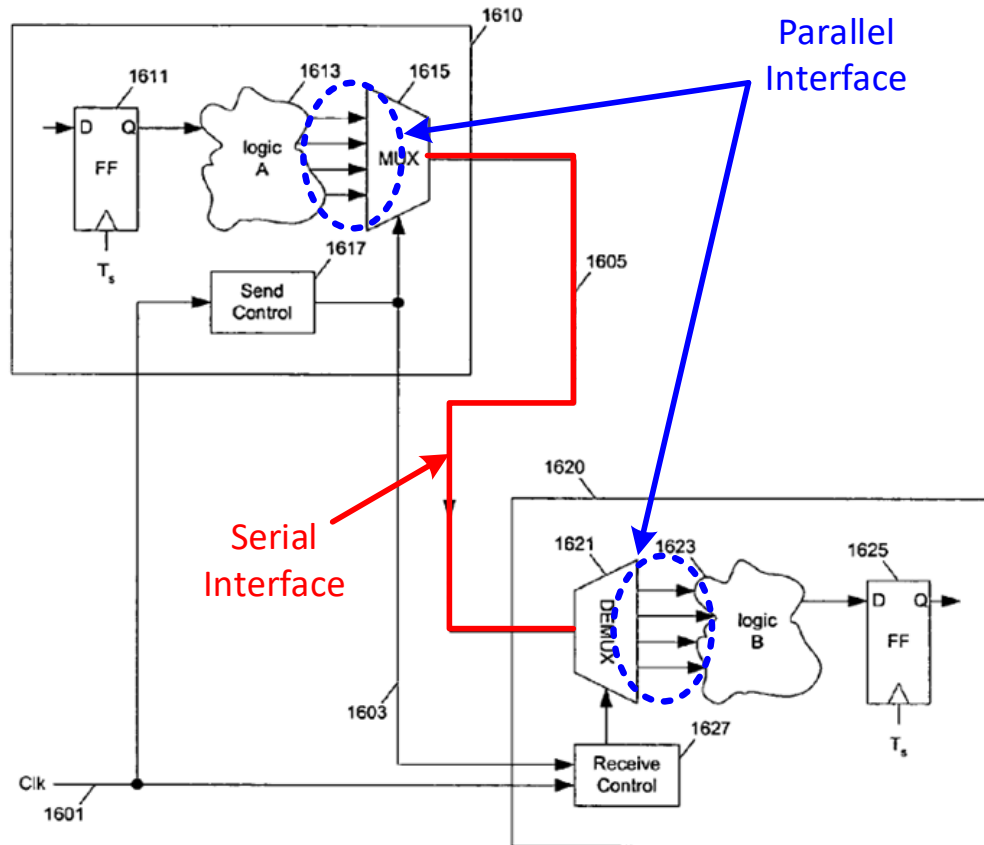
252. As I discuss above, Zhang is cited against various claims above for disclosing the claimed “serial interface” in claims 1, 14, 36, 50, 64, and 78 (and claims 3-7, 9-13, 16-20, and 22-26, which depend from claim 1 or 14), and cited for disclosing the claimed “parallel interface” in claims 35, 49, 63, and 77. In addition to Zhang teaching serial and parallel interfaces as discussed above with respect to these claims, Pandey also teaches these elements.

253. Pandey teaches a computer aided technique for implementing a digital circuit design (e.g., such as Zhang’s digital circuitry) on a FPGA or ASIC chip. Ex. 1014, Abstract, 1:15-55, 2:4-12. The process partitions functional blocks (such as Zhang’s channel demultiplexer 230, digital selector 240, and demodulators 250) into different regions of an integrated circuit chip (e.g., 301, 303, 305, 307) and assigns wires (e.g., 351, 353, 355, 357) to interconnect the partitioned blocks. Ex. 1014, 1:56-60, 2:6-12, 2:64-3:27, 6:10-15, 11:6-19, 13:33-14:7.



Ex. 1014, Fig. 3

254. Pandey recognizes that the number of signals (nets) between function blocks in different partitions may exceed the number of traces (physical wires) available inside a chip, and that in such cases, multiple signals must be time-multiplexed (i.e. transmitted serially) over a single trace. Ex. 1014, 10:24-53, 10:58-11:5, 29:44-58, 30:31-42. For example, as shown below, logic blocks A 1613 and B 1623 in separate partitions include a plurality of parallel signals to be transmitted from one to the other, i.e., via parallel interfaces (**blue**). Ex. 1014, 30:31-52, Fig. 37. Multiplexer 1615 time multiplexes the signals from the parallel interface of 1613 onto a single trace (serial interface) (**red**), and then demultiplexer 1621 demultiplexes the signals back to the parallel interface of logic block B 1623. *Id.*

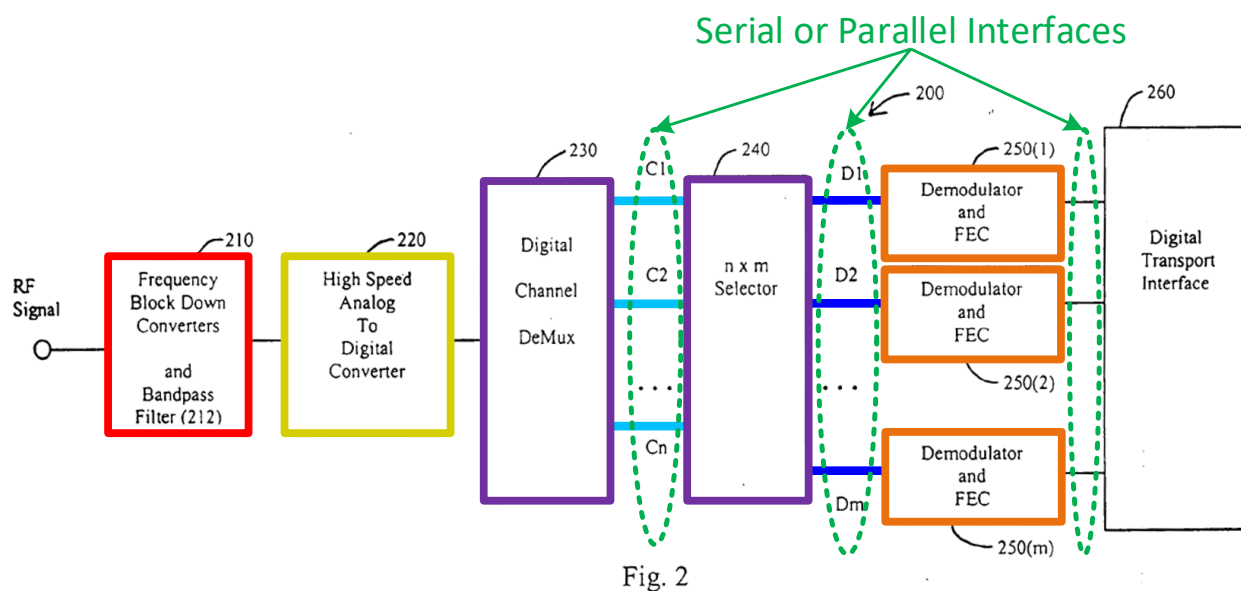


Ex. 1014, Fig. 37

255. Pandey's process partitions the blocks based on reducing the multiplexing ratio of wires to signals required between partitions. Ex. 1014, 5:50-53, 6:11-15, 6:44-53, 7:13-19, 29:44-30:9, 30:53-31:12, 31:56-63, Figs. 38-39. Depending upon the partitioning of the circuit design within finite area and finite interconnection of a chip, Pandey's optimization will in some layouts produces signals having individual dedicated traces with no multiplexing, resulting in only parallel interfaces between partitions, and in other layouts, produce signals between the partitions that are converted from a parallel interface, to a serial interface, and back to a parallel interface. Ex. 1014, 31:20-22, 32:12-15. Thus, Pandey teaches

both serial and parallel interfaces for signals between digital functional blocks, with the implementation depending on upon the designer's selection of a particular integrated chip and the size of the circuit design (e.g., the number of channels to demodulate). Ex. 1014, 11:6-19, 13:33-55, 31:20-22, 32:12-15, Figs. 2-3.

256. It would have been obvious to apply Pandey's optimization for dedicated (i.e., parallel) and/or time-multiplexed (i.e., serial) interconnections to the interconnection between Zhang's demultiplexer 230, digital selector 240, demodulators 250, and/or digital transport interface 260 as shown below.



Ex. 1013, Fig. 2 (annotated)

257. Zhang teaches optimizing the real estate needed for implementing the digital portion of its system on a single chip, and a POSITA would have looked to Pandey because it provides such optimization (using serial and parallel interfaces). Ex. 1013, [0029], [0037], [0044], [0047]-[0048]; Ex. 1014, 1:20-2:12, 6:10-15. A

designer, implementing Zhang's circuit using Pandey's process will decide on the number of RF channels to demodulate, and thus the number of functional blocks (e.g. complex multipliers, filters) to be implemented. Ex. 1013, [0028]-[0030], [0040], [0042]. A designer implementing a larger circuit design to demodulate a large number of RF channels would predictably lead to insufficient trace resources, resulting in Pandey's optimization inserting serial interfaces in between parallel interfaces of Zhang's digital blocks as shown in Pandey's Figure 37 above. Ex. 1014, 31:15-22, 32:7-15. A designer implementing a smaller circuit for a small number of RF channels would predictably result in Pandey's optimization assigning each signal to its own trace, thus producing parallel interfaces between Zhang's digital blocks. *Id.*

258. As such, the modification of Zhang with Pandey that results (depending on chip area and resources) in parallel and/or serial interfaces between Zhang's digital demultiplexer 230, digital selector 240, demodulators 250, and/or digital transport interface 260 is nothing more than a combination of prior art elements (Zhang's circuit design and Pandey's parallel and serial interfaces between blocks) according to known methods (Pandey's optimization of chip layout and interconnection) to yield predictable results (data is transmitted effectively using serial and parallel interfaces).

259. A POSITA would have had a reasonable expectation of success in combining Zhang and Pandey, because Pandey's optimization utilized processes such as floor planning, partitioning, and wire routing that were standard and well within a POSITA's skillset. Ex. 1014, 1:20-2:38.

260. Thus, it is my opinion that claims 1, 3-7, 9, 11, 13, 14, 16-20, 22, 24, 26, 35-36, and 49-50 are obvious over Zhang in view of Pandey, and claim 10-12, 23-25, 35-36, 49-50, 63-64, and 77-78 are obvious over Zhang in view of Reisman and Pandey. *See* Sections 9.2.1, 9.2.2, 9.2.5-9.2.10, *supra*.

9.5.2. Dependent Claims 8, 21, 34, 48, 62, 76

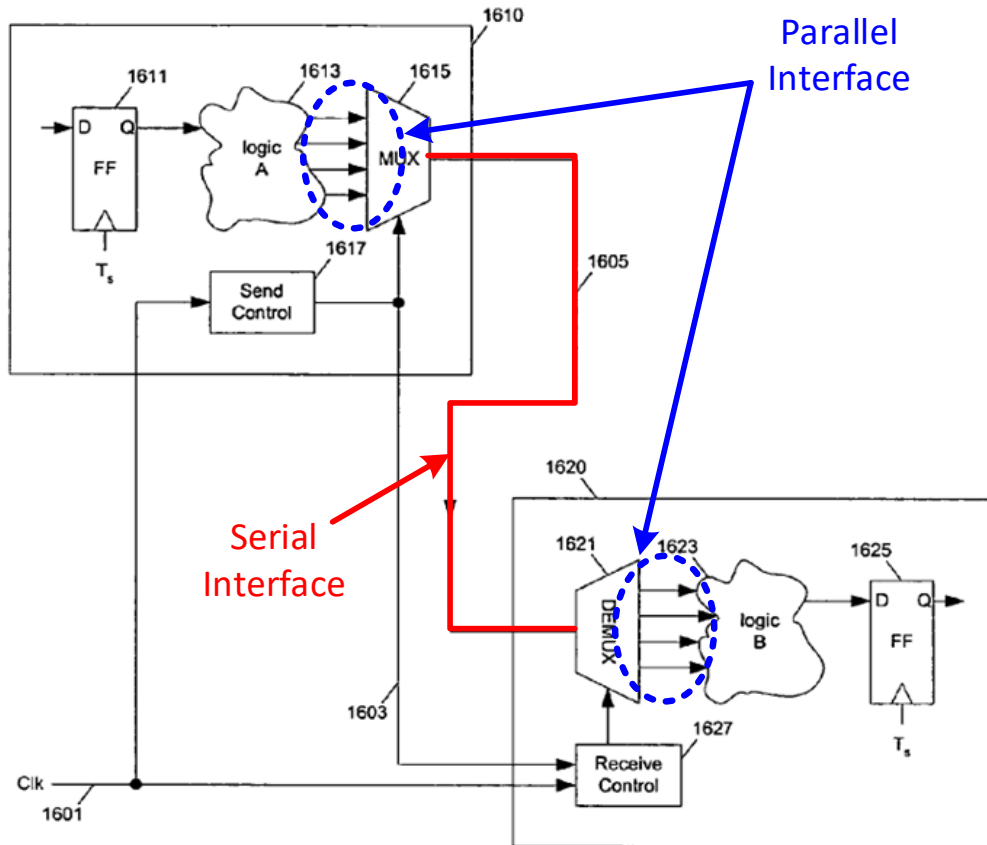
[8/34/62] "The cable TV device of claim [7/33/61], wherein: the DFE is operable to provide a plurality of demodulated desired channels via a parallel interface."

[21/48/76] "The cable TV device of claim [20/47/75], wherein: the plurality of digital down converters is operable to provide a plurality of demodulated desired channels via a parallel interface."

261. As I discuss above with respect to claims 7, 20, 33, 47, 61, and 75, Zhang teaches providing the demodulated channels at the output of Demodulators 250(1)-250(m), and as discussed in the previous section, the combination of Zhang and Pandey teaches that it would have been obvious for Zhang's Demodulator outputs to be implemented with a parallel interface. *See* Sections 9.2.10, 9.3.8, 9.5.1. Thus, the combination of Zhang and Pandey render obvious claims 8, 21, 34, and 48, and the combination of Zhang, Reisman, and Pandey render obvious claims 34, 48, 62, and 78, for the same reasons discussed above with respect to their base claims

1, 14, 27, 41, 55, and 69, and further based on the additional teachings of Pandey as discussed above. *See* Section 9.4.1.

262. As discussed above (*see* Section 9.2.), claims 7 and 20 (from which claims 8 and 21 depend) require each desired channel/digital channel output to be provided “via a serial interface.” To the extent this requires a serial interface at the outputs of the demodulators, claims 8 and 21 would further require the demodulator outputs to also have a parallel interface. As described in the previous section (9.5.1), Zhang-Pandey teaches this. As shown below, Pandey’s optimization inserts serial interfaces in between parallel interfaces of different partitions (e.g., between Zhang’s demodulators 250 and digital transport interface 260). *Id.* Thus, Zhang-Pandey render claims 8 and 21 obvious even if these claims are understood to provide demodulated channels via both serial and parallel interfaces. *Id.*



Ex. 1014, Fig. 37 (annotated)

9.6. Zhang in view Pandey and Jackson Render Claims 2-6 and 15-19 Obvious (Ground H)

263. As I discuss above in ground D, Jackson is cited for teaching certain features of claims 2-6 and 15-19, and in ground F, Pandey is cited for teaching serial and parallel interfaces of independent claims 1 and 14 from which claims 2-6 and 15-19 depend. As these features in combination with Zhang are independent from one another, it would have been obvious to combine Zhang with Jackson and with Pandey for the reasons discussed above with respect to grounds D and F. *See* Sections 9.4, 9.5, *supra*.

264. Thus, it is my opinion that claims 2-6 and 15-19 are taught by the combination of Zhang in view of Pandey, and further in view of Jackson.

10. CONCLUSION

265. All of the statements made in this declaration of my own knowledge are true. All statements made based on information and belief are believed to be true.

I declare under penalty of perjury that the foregoing is true and correct.

Dated: 2/16/2024 By: David B. Lett

David B. Lett

11. CLAIMS LISTING APPENDIX

U.S. Pat. No. 11,381,866

Designation Claim Language	
Claim 1	
[1A]	A cable television (TV) device comprising:
[1B]	a wideband analog-to-digital converter (ADC) configured to digitize a contiguous band of frequencies in an input signal, wherein the contiguous band of frequencies comprises a plurality of desired channels and a plurality of undesired channels; and
[1C]	a digital frontend (DFE) coupled to the wideband ADC, wherein the DFE is configured to concurrently select and provide each of the plurality of desired channels, via a serial interface, without providing any of the plurality of undesired channels.
Claim 2	
2	The cable TV device of claim 1, wherein: the cable TV device comprises a cable network connector, and the input signal is operably communicated from the cable network connector to the wideband ADC via at least one of an analog amplifier and an analog filter.
Claim 3	

Designation	Claim Language
3	The cable TV device of claim 1, wherein: the DFE comprises a plurality of mixers, and each mixer, of the plurality of mixers, is operable to generate a corresponding complex signal comprising an in-phase (I) component and a quadrature (Q) component.
Claim 4	
4	The cable TV device of claim 3, wherein: the I and Q components of each corresponding complex signal are at baseband.
Claim 5	
5	The cable TV device of claim 3, wherein: the DFE comprises a plurality of filters, and each filter, of the plurality of filters, is operable to filter the corresponding complex signal comprising a 6 MHz channel.
Claim 6	
6	The cable TV device of claim 3, wherein:

Designation	Claim Language
	the DFE comprises a plurality of digital demodulators, and each digital demodulator, of the plurality of digital demodulators, is operable to demodulate the corresponding complex signal.
Claim 7	
7	The cable TV device of claim 1, wherein: the DFE comprises a plurality of digital demodulators, and each digital demodulator, of the plurality of digital demodulators, is operable to demodulate a desired channel, of the plurality of desired channels.
Claim 8	
8	The cable TV device of claim 7, wherein: the DFE is operable to provide a plurality of demodulated desired channels via a parallel interface.
Claim 9	
9	The cable TV device of claim 1, wherein: the plurality of desired channels comprises at least one cable broadcast channel.
Claim 10	
10	The cable TV device of claim 1, wherein:

Designation Claim Language	
	the plurality of desired channels comprises at least one channel delivered via a Data Over Cable Service Interface Specification (DOCSIS) protocol.
Claim 11	
11	The cable TV device of claim 1, wherein: the cable TV device comprises a digital video recorder (DVR).
Claim 12	
12	The cable TV device of claim 1, wherein: the cable TV device is operable to configure at least some of the plurality of desired channels as an output for a picture-in-picture display.
Claim 13	
13	The cable TV device of claim 1, wherein: the contiguous band of frequencies comprises a portion of a frequency spectrum of the input signal.
Claim 14	
[14A]	A cable TV device comprising:
[14B]	a wideband analog-to-digital converter (ADC) configured to digitize an input signal, wherein the input signal comprises a plurality of desired channels and a plurality of undesired channels; and
[14C]	a plurality of digital down converters coupled to the wideband ADC, 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, and

Designation	Claim Language
[14D]	wherein the plurality of digital down converters is operable to provide each digital channel output via a serial interface.
Claim 15	
15	The cable TV device of claim 14, wherein: the cable TV device comprises a cable network connector, and the input signal is operably communicated from the cable network connector to the wideband ADC via at least one of an analog amplifier and an analog filter.
Claim 16	
16	The cable TV device of claim 14, wherein: each digital down converter comprises a digital mixer operable to generate a corresponding complex signal comprising an in-phase (I) component and a quadrature (Q) component.
Claim 17	
17	The cable TV device of claim 16, wherein: the I and Q components of each corresponding complex signal are at baseband.
Claim 18	
18	The cable TV device of claim 16, wherein: each digital down converter comprises a filter operable to select the corresponding complex signal comprising a 6 MHz channel.
Claim 19	
19	The cable TV device of claim 16, wherein:

Designation Claim Language	
	each digital down converter comprises a digital demodulator operable to demodulate the corresponding complex signal to provide a demodulated channel as the digital channel output.
Claim 20	
20	The cable TV device of claim 14, wherein: each digital down converter comprises a digital demodulator operable to demodulate a desired channel, of the plurality of desired channels, to provide a demodulated channel as the digital channel output.
Claim 21	
21	The cable TV device of claim 20, wherein: the plurality of digital down converters is operable to provide a plurality of demodulated desired channels via a parallel interface.
Claim 22	
22	The cable TV device of claim 14, wherein: the plurality of desired channels comprises at least one cable broadcast channel.
Claim 23	
23	The cable TV device of claim 14, wherein: the plurality of desired channels comprises at least one channel delivered via a Data Over Cable Service Interface Specification (DOCSIS) protocol.
Claim 24	
24	The cable TV device of claim 14, wherein: the cable TV device comprises a digital video recorder (DVR).
Claim 25	

Designation	Claim Language
25	The cable TV of claim 14, wherein: the cable TV device is operable to provide a picture-in-picture display according to the plurality of digital channel outputs.
Claim 26	
26	The cable TV device of claim 14, wherein: the plurality of desired channels and the plurality of undesired channels comprise a portion of a frequency spectrum of the input signal.
Claim 27	
[27A]	A cable television (TV) device comprising:
[27B]	a wideband analog-to-digital converter (ADC) configured to digitize a contiguous band of frequencies in an input signal, wherein the contiguous band of frequencies comprises a plurality of desired channels and a plurality of undesired channels; and
[27C]	a digital frontend (DFE) coupled to the wideband ADC, wherein the DFE is configured to concurrently select and provide each of the plurality of desired channels without providing any of the plurality of undesired channels, and
[27D]	wherein the cable TV device comprises a digital video recorder (DVR).
Claim 28	
28	The cable TV device of claim 27, wherein: the cable TV device comprises a cable network connector, and the input signal is operably communicated from the cable network

Designation	Claim Language
	connector to the wideband ADC via at least one of an analog amplifier and an analog filter.
Claim 29	
29	The cable TV device of claim 27, wherein: the DFE comprises a plurality of mixers, and each mixer, of the plurality of mixers, is operable to generate a corresponding complex signal comprising an in-phase (I) component and a quadrature (Q) component.
Claim 30	
30	The cable TV device of claim 29, wherein: the I and Q components of each corresponding complex signal are at baseband.
Claim 31	
31	The cable TV device of claim 29, wherein: the DFE comprises a plurality of filters, and each filter, of the plurality of filters, is operable to filter the corresponding complex signal comprising a 6 MHz channel.
Claim 32	
32	The cable TV device of claim 29, wherein: the DFE comprises a plurality of digital demodulators, and each digital demodulator, of the plurality of digital demodulators, is operable to demodulate the corresponding complex signal.
Claim 33	
33	The cable TV device of claim 27, wherein:

Designation Claim Language	
	the DFE comprises a plurality of digital demodulators, and each digital demodulator, of the plurality of digital demodulators, is operable to demodulate a desired channel, of the plurality of desired channels.
Claim 34	
34	The cable TV device of claim 33, wherein: the DFE is operable to provide a plurality of demodulated desired channels via a parallel interface.
Claim 35	
35	The cable TV device of claim 27, wherein: the DFE is operable to provide the plurality of desired channels via a parallel interface.
Claim 36	
36	The cable TV device of claim 27, wherein: the DFE is operable to provide the plurality of desired channels via a serial interface.
Claim 37	
37	The cable TV device of claim 27, wherein: the plurality of desired channels comprises at least one cable broadcast channel.
Claim 38	
38	The cable TV device of claim 27, wherein: the plurality of desired channels comprises at least one channel delivered via a Data Over Cable Service Interface Specification (DOCSIS) protocol.

Designation Claim Language	
Claim 39	
39	The cable TV device of claim 27, wherein: the cable TV device is operable to configure at least some of the plurality of desired channels as an output for a picture-in-picture display.
Claim 40	
40	The cable TV device of claim 27, wherein: the contiguous band of frequencies comprises a portion of a frequency spectrum of the input signal.
Claim 41	
[41A]	A cable TV device comprising:
[41B]	a wideband analog-to-digital converter (ADC) configured to digitize an input signal, wherein the input signal comprises a plurality of desired channels and a plurality of undesired channels; and
[41C]	a plurality of digital down converters coupled to the wideband ADC, 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, and
[41D]	wherein the cable TV device comprises a digital video recorder (DVR).
Claim 42	
42	The cable TV device of claim 41, wherein: the cable TV device comprises a cable network connector, and the input signal is operably communicated from the cable network

Designation Claim Language	
	connector to the wideband ADC via at least one of an analog amplifier and an analog filter.
Claim 43	
43	The cable TV device of claim 41, wherein: each digital down converter comprises a digital mixer operable to generate a corresponding complex signal comprising an in-phase (I) component and a quadrature (Q) component.
Claim 44	
44	The cable TV device of claim 43, wherein: the I and Q components of each corresponding complex signal are at baseband.
Claim 45	
45	The cable TV device of claim 43, wherein: each digital down converter comprises a filter operable to select the corresponding complex signal comprising a 6 MHz channel.
Claim 46	
46	The cable TV device of claim 43, wherein: each digital down converter comprises a digital demodulator operable to demodulate the corresponding complex signal to provide a demodulated channel as the digital channel output.
Claim 47	
47	The cable TV device of claim 41, wherein: each digital down converter comprises a digital demodulator operable to demodulate a desired channel, of the plurality of desired

Designation	Claim Language
	channels, to provide a demodulated channel as the digital channel output.
Claim 48	
48	The cable TV device of claim 47, wherein: the plurality of digital down converters is operable to provide a plurality of demodulated desired channels via a parallel interface.
Claim 49	
49	The cable TV device of claim 41, wherein: the plurality of digital down converters is operable to provide a plurality of digital channel outputs, comprising each digital channel output, via a parallel interface.
Claim 50	
50	The cable TV device of claim 41, wherein: the plurality of digital down converters is operable to provide each digital channel output via a serial interface.
Claim 51	
51	The cable TV device of claim 41, wherein: the plurality of desired channels comprises at least one cable broadcast channel.
Claim 52	
52	The cable TV device of claim 41, wherein: the plurality of desired channels comprises at least one channel delivered via a Data Over Cable Service Interface Specification (DOCSIS) protocol.
Claim 53	

Designation	Claim Language
53	The cable TV of claim 41, wherein: the cable TV device is operable to provide a picture-in-picture display according to the plurality of digital channel outputs.
Claim 54	
54	The cable TV device of claim 41, wherein: the plurality of desired channels and the plurality of undesired channels comprise a portion of a frequency spectrum of the input signal.
Claim 55	
[55A]	A cable television (TV) device comprising:
[55B]	a wideband analog-to-digital converter (ADC) configured to digitize a contiguous band of frequencies in an input signal, wherein the contiguous band of frequencies comprises a plurality of desired channels and a plurality of undesired channels; and
[55C]	a digital frontend (DFE) coupled to the wideband ADC, wherein the DFE is configured to concurrently select and provide each of the plurality of desired channels without providing any of the plurality of undesired channels, and
[55D]	wherein the cable TV device is operable to configure at least some of the plurality of desired channels as an output for a picture-in-picture display.
Claim 56	
56	The cable TV device of claim 55, wherein: the cable TV device comprises a cable network connector, and the input signal is operably communicated from the cable network

Designation	Claim Language
	connector to the wideband ADC via at least one of an analog amplifier and an analog filter.
Claim 57	
57	The cable TV device of claim 55, wherein: the DFE comprises a plurality of mixers, and each mixer, of the plurality of mixers, is operable to generate a corresponding complex signal comprising an in-phase (I) component and a quadrature (Q) component.
Claim 58	
58	The cable TV device of claim 57, wherein: the I and Q components of each corresponding complex signal are at baseband.
Claim 59	
59	The cable TV device of claim 57, wherein: the DFE comprises a plurality of filters, and each filter, of the plurality of filters, is operable to filter the corresponding complex signal comprising a 6 MHz channel.
Claim 60	
60	The cable TV device of claim 57, wherein: the DFE comprises a plurality of digital demodulators, and each digital demodulator, of the plurality of digital demodulators, is operable to demodulate the corresponding complex signal.
Claim 61	
61	The cable TV device of claim 55, wherein:

Designation Claim Language	
	the DFE comprises a plurality of digital demodulators, and each digital demodulator, of the plurality of digital demodulators, is operable to demodulate a desired channel, of the plurality of desired channels.
Claim 62	
62	The cable TV device of claim 61, wherein: the DFE is operable to provide a plurality of demodulated desired channels via a parallel interface.
Claim 63	
63	The cable TV device of claim 55, wherein: the DFE is operable to provide the plurality of desired channels via a parallel interface.
Claim 64	
64	The cable TV device of claim 55, wherein: the DFE is operable to provide the plurality of desired channels via a serial interface.
Claim 65	
65	The cable TV device of claim 55, wherein: the plurality of desired channels comprises at least one cable broadcast channel.
Claim 66	
66	The cable TV device of claim 55, wherein: the plurality of desired channels comprises at least one channel delivered via a Data Over Cable Service Interface Specification (DOCSIS) protocol.

Designation Claim Language	
Claim 67	
67	The cable TV device of claim 55, wherein: the cable TV device comprises a digital video recorder (DVR).
Claim 68	
68	The cable TV device of claim 55, wherein: the contiguous band of frequencies comprises a portion of a frequency spectrum of the input signal.
Claim 69	
[69A]	A cable TV device comprising:
[69B]	a wideband analog-to-digital converter (ADC) configured to digitize an input signal, wherein the input signal comprises a plurality of desired channels and a plurality of undesired channels; and
[69C]	a plurality of digital down converters coupled to the wideband ADC, 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, and
[69D]	wherein the cable TV device is operable to provide a picture-in-picture display according to the plurality of digital channel outputs.
Claim 70	
70	The cable TV device of claim 69, wherein: the cable TV device comprises a cable network connector, and the input signal is operably communicated from the cable network connector to the wideband ADC via at least one of an analog amplifier and an analog filter.

Designation Claim Language	
Claim 71	
71	The cable TV device of claim 69, wherein: each digital down converter comprises a digital mixer operable to generate a corresponding complex signal comprising an in-phase (I) component and a quadrature (Q) component.
Claim 72	
72	The cable TV device of claim 71, wherein: the I and Q components of each corresponding complex signal are at baseband.
Claim 73	
73	The cable TV device of claim 71, wherein: each digital down converter comprises a filter operable to select the corresponding complex signal comprising a 6 MHz channel.
Claim 74	
74	The cable TV device of claim 71, wherein: each digital down converter comprises a digital demodulator operable to demodulate the corresponding complex signal to provide a demodulated channel as the digital channel output.
Claim 75	
75	The cable TV device of claim 69, wherein: each digital down converter comprises a digital demodulator operable to demodulate a desired channel, of the plurality of desired channels, to provide a demodulated channel as the digital channel output.
Claim 76	
76	The cable TV device of claim 75, wherein:

Designation Claim Language	
	the plurality of digital down converters is operable to provide a plurality of demodulated desired channels via a parallel interface.
Claim 77	
77	The cable TV device of claim 69, wherein: the plurality of digital down converters is operable to provide a plurality of digital channel outputs, comprising each digital channel output, via a parallel interface.
Claim 78	
78	The cable TV device of claim 69, wherein: the plurality of digital down converters is operable to provide each digital channel output via a serial interface.
Claim 79	
79	The cable TV device of claim 69, wherein: the plurality of desired channels comprises at least one cable broadcast channel.
Claim 80	
80	The cable TV device of claim 69, wherein: the plurality of desired channels comprises at least one channel delivered via a Data Over Cable Service Interface Specification (DOCSIS) protocol.
Claim 81	
81	The cable TV device of claim 69, wherein: the cable TV device comprises a digital video recorder (DVR).
Claim 82	
82	The cable TV device of claim 69, wherein:

Designation	Claim Language
	the plurality of desired channels and the plurality of undesired channels comprise a portion of a frequency spectrum of the input signal.