

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. 11,399,206
Filing Date: January 28, 2022
Issue Date: July 26, 2022
Title: METHOD FOR RECEIVING A TELEVISION SIGNAL

Inter Partes Review No.: IPR2024-00438

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

	Page
1. INTRODUCTION.....	1
2. PROFESSIONAL BACKGROUND AND QUALIFICATIONS	2
3. MATERIALS CONSIDERED	8
4. UNDERSTANDING OF APPLICABLE LEGAL STANDARDS.....	11
5. THE RELEVANT ART AND LEVEL OF ORDINARY SKILL IN THE RELEVANT ART	17
6. CLAIM CONSTRUCTION	18
7. OVERVIEW OF THE '206 PATENT	19
7.1. Prosecution History	21
7.2. Earliest Priority Date for the Claims.....	22
8. OVERVIEW OF THE PRIOR ART.....	23
8.1. Cable and Satellite Television Networks.....	23
8.2. Modulated RF Signals	25
8.3. Radio Receivers or Tuners for Cable and Satellite Television Networks.....	31
8.4. Serial vs. Parallel Data Communication.....	47
8.5. U.S. Publication No. 2003/0056221 – Zhang (Ex. 1013).....	48
8.6. U.S. Pub. No. 2003/0229900 – Reisman (Ex. 1052).....	52
8.7. U.S. Pub. No. 2009/0113504 – Jackson (Ex. 1057)	54
8.8. U.S. Patent No. 7,237,214 – Pandey (Ex. 1014)	56
9. OPINIONS WITH RESPECT TO THE '206 PATENT	58
9.1. Summary of the Grounds and Comparison of Claim Limitations.....	58
9.2. Grounds A/B: Zhang.....	64
9.3. Ground C: Zhang/Reisman	98
9.4. Zhang in View of Jackson Render Claims 2-6, 14-18, 26-30, and 39-43 Obvious (Ground D), and Zhang in View of Reisman and Jackson Render Claims 26-30, 39-43, 52-56 and 65-69 Obvious (Ground E)	113

9.5.	Ground F: Zhang-Pandey Render (Claims 1, 3-9, 11, 13, 15-21, 23, 32-34, 45-47), and Ground G: Zhang-Reisman-Pandey (Claims 9-12, 21-24, 32-34, 45-47, 58-60, 71-73)	129
9.6.	Zhang in view Pandey and Jackson Render Claims 2-6 and 14-18 Obvious (Ground H)	136
10.	CONCLUSION.....	137
	CLAIM LISTING APPENDIX.....	138

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. 11,399,206 (“the ’206 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 ’206 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 '206 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 '206 patent (U.S. Pat. No. 11,399,206 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 '206 patent (included in Ex. 1004) as well as the following references:

Ex. 1001: U.S. Patent No. 11,399,206 (“the '206 patent”)

Ex. 1003: Curriculum Vitae of David B. Lett

Ex. 1004: Certified Prosecution History of the '206 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. 11,399,206

- 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 '206 patent based on the following grounds:

Ground	References	Basis	Claims Challenged
A	Zhang	35 U.S.C. §102	1, 3-7, 9, 11, 13, 15-19, 21, 23,

		(anticipation)	25 , 27-31, 33-35, 38 , 40-44, 46-48
B	Zhang	35 U.S.C. §103 (obviousness)	1 , 3-7, 9, 11, 13 , 15-19, 21, 23, 25 , 27-31, 33-35, 38 , 40-44, 46-48
C	Zhang-Reisman	35 U.S.C. §103 (obviousness)	9-12, 21-24, 25 , 27-31, 33-37, 38 , 40-44, 46-50, 51 , 53-57, 59-63, 64 , 66-70, 72-76
D	Zhang- Jackson	35 U.S.C. §103 (obviousness)	2-6, 14-18, 26-30, 39-43
E	Zhang-Reisman- Jackson	35 U.S.C. §103 (obviousness)	26-30, 39-43, 52-56, 65- 69
F	Zhang-Pandey	35 U.S.C. §103 (obviousness)	1 , 3-9, 11, 13 , 15-21, 23, 32-34, 45-47
G	Zhang-Reisman- Pandey	35 U.S.C. §103 (obviousness)	9-12, 21-24, 32-34, 45- 47, 58-60, 71-73

H	Zhang-Pandey- Jackson	35 U.S.C. §103 (obviousness)	2-6, 14-18
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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 ’206 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, 1:30-35; *see also id.*, 4:35-37. 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 (POSITA) of the ’206 patent, at the time of the alleged invention of the ’206 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 ’206 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 ’206 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 '206 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 '206 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.

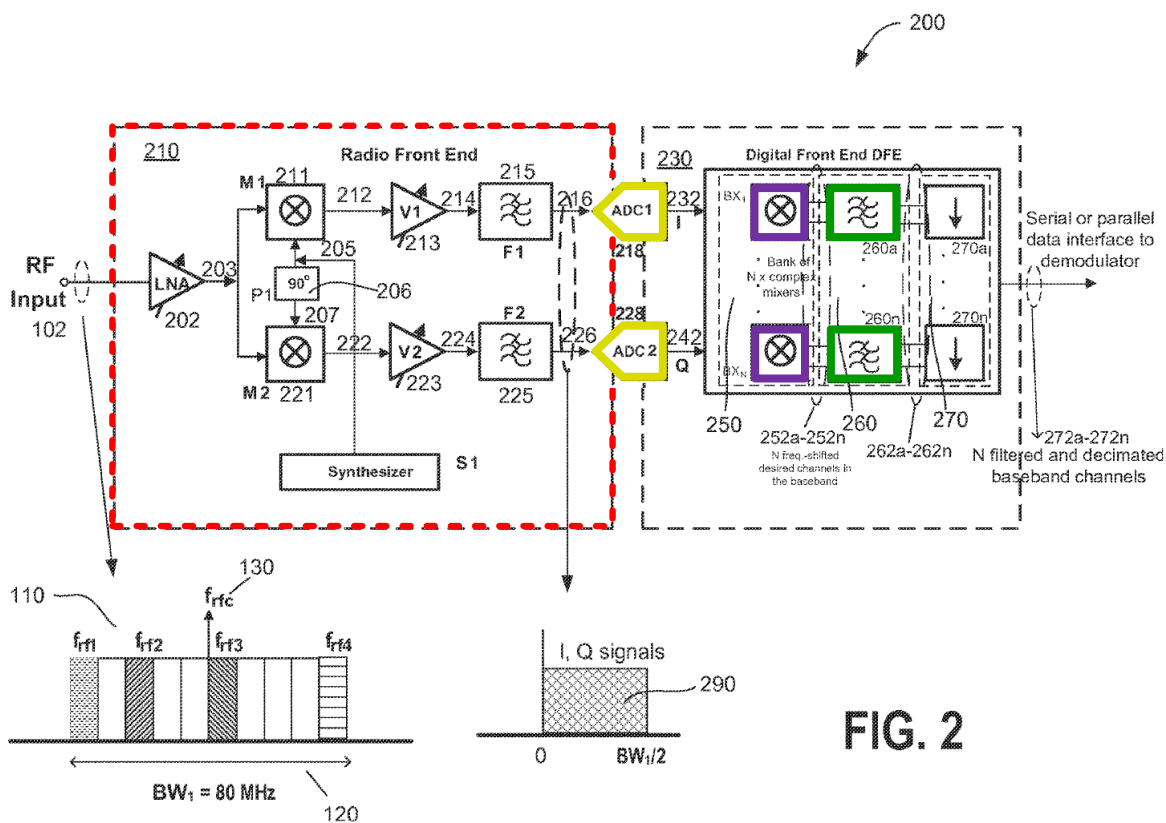
34. I understand that all claim terms herein should be given their ordinary and customary meaning to a POSITA, consistent with the prosecution history, as they would be given in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b). It is my understanding that Petitioner does not contend that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

35. The claims use the term “wideband.” The '206 patent implicitly defines “wideband” as a band that carries multiple channels. For example, the '206 patent

states that a receiver is “wideband” if it is “designed to concurrently receive several TV channels.” Ex. 1001, 1:36-39. This is consistent with the ordinary and customary meaning of “wideband.”

7. OVERVIEW OF THE '206 PATENT

36. The '206 patent describes a wideband receiver system 200 illustrated below for “capable of receiving multiple radio frequency channels located in a broad radio frequency spectrum.” Ex. 1001, 1:30-35; *see also id.*, 4:35-37. According to the '206 patent, a receiver is “wideband” if it is “designed to concurrently receive several TV channels.” *Id.*, 1:36-39.



Ex. 1001, Fig. 2 (annotated)

37. The system 200 receives desired and undesired television channels as frequencies dispersed within a frequency bandwidth BW_1 . Ex. 1001, 4:38-51. 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**). *Id.*, 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 ’206 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, 1:20-22.

38. 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. *Id.*, 6:2-8. Filters 260a-260n (each annotated above in **green**) filter each frequency-shifted desired channel. *Id.* 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.” *Id.*, 7:10-13.

7.1. Prosecution History

39. It is my understanding that U.S. Application No. 17/587,462, which became the '206 patent, was filed on January 28, 2022, with a preliminary amendment cancelling claims 1-18 and adding new claims 19-48. Ex. 1004 at 2-9. On April 13, 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) in view of International Publication No. WO 02/087230 (Uskali). *Id.* at 119-133. The Office Action indicated that dependent claims 28 and 43 (which recited providing channels “via a serial interface”), claims 31 and 46 (which recited performing the method by “a device comprising a digital video recorder (DVR)”), and claims 32 and 47 (which recited “a picture-in-picture display”) contained allowable subject matter. *Id.* at 6-9, 131.

40. On April 14, 2022, the Applicant filed a terminal disclaimer and an amendment that added the limitations of claim 28 to claim 19, added the limitations of claim 43 to claim 34, added new independent claim 49 based on original claims 19 and 31, added new independent claim 63 based on original claims 34 and 46, added new independent claim 77 based on original claims 19 and 32, added new independent claim 91 based on original claims 34 and 47, and added multiple sets of new dependent claims that paralleled existing dependent claims. *Id.* at 220-238.

41. On June 2, 2022, the Applicant filed a supplemental amendment that amended claims 19, 49, and 77 ('206 patent claims 1, 25, and 51, respectively) to add “receiving an input signal from a cable network” and amend the “digitizing” step: “... wherein the contiguous band of frequencies comprises all received channels that exist in the input signal and the received channels comprise[[s]] a plurality of desired channels and a plurality of undesired channels.” *Id.* at 260-268. That supplemental amendment also amended claims 34, 63, and 91 ('206 patent claims 13, 38, and 64, respectively) to add “receiving an input signal from a cable network” and amend the “digitizing” step: “digitizing ~~an~~ all received channels in the input signal ... wherein the input signal comprises received channels comprise a plurality of desired channels and a plurality of undesired channels.” *Id.* at 262-270. The Office issued a Notice of Allowance on June 15, 2022. *Id.* at 275. The '206 patent issued on July 26, 2022. Ex. 1001, cover.

42. The prior art relied upon in this petition—Zhang, Reisman, Jackson, and Pandey—was not considered during prosecution of the '462 application. Ex. 1001 at 1-2.

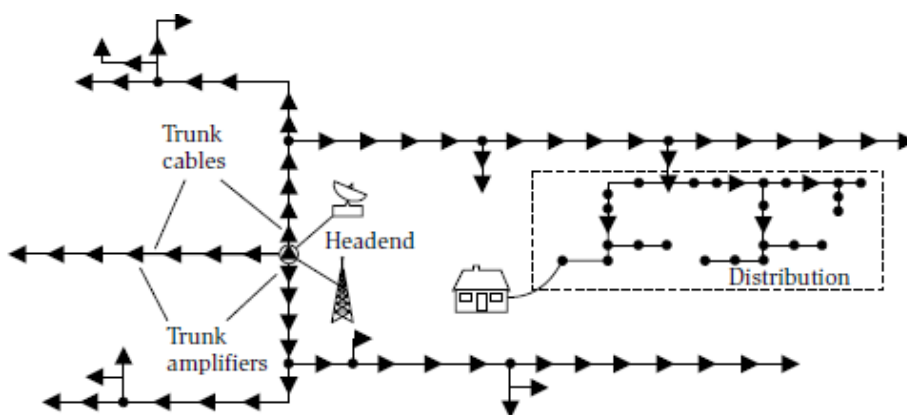
7.2. Earliest Priority Date for the Claims

43. The earliest possible effective filing date for the '206 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

44. The origins of the cable and satellite television networks long predate the earliest claimed priority date (April 17, 2009) of the '206 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.

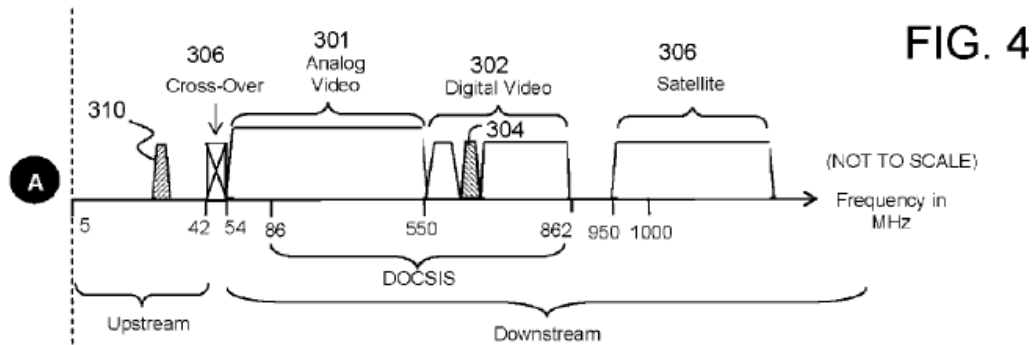


Ex. 1033, Fig. 1.1 (Excerpted) (Page 34)

RF is the frequency range starting from 10 kHz to 100,000 MHz 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.

45. 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)

46. 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.

47. 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.

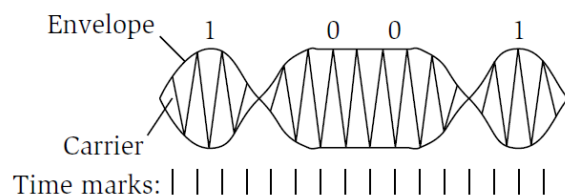
8.2. Modulated RF Signals

48. 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 '206 patent, multiple modulation techniques facilitating high spectral efficiencies were known to a POSITA.

8.2.1. Biphase Shift Keying

49. 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.

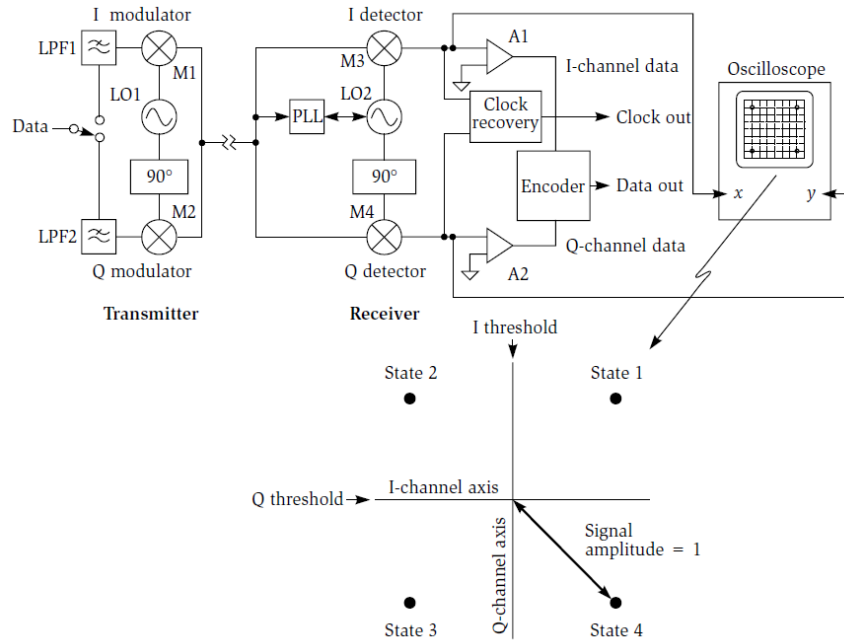


Ex. 1033, Fig. 4.3 (Excerpted) (page 161)

8.2.2. Quadrature Phase Shift Keying (QPSK)

50. 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.



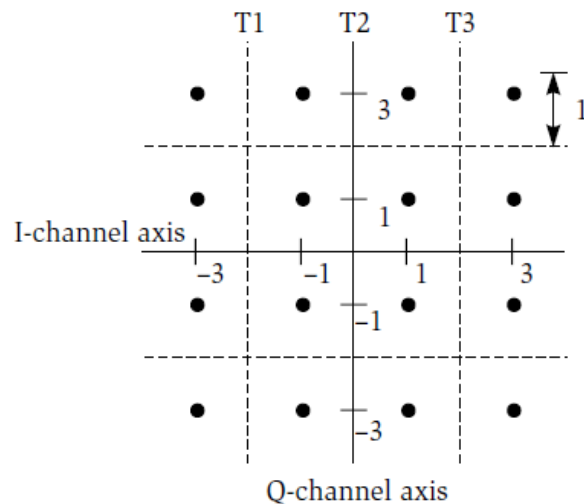
Ex. 1033, Fig. 4.4 (page 164)

51. 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.

52. 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.*

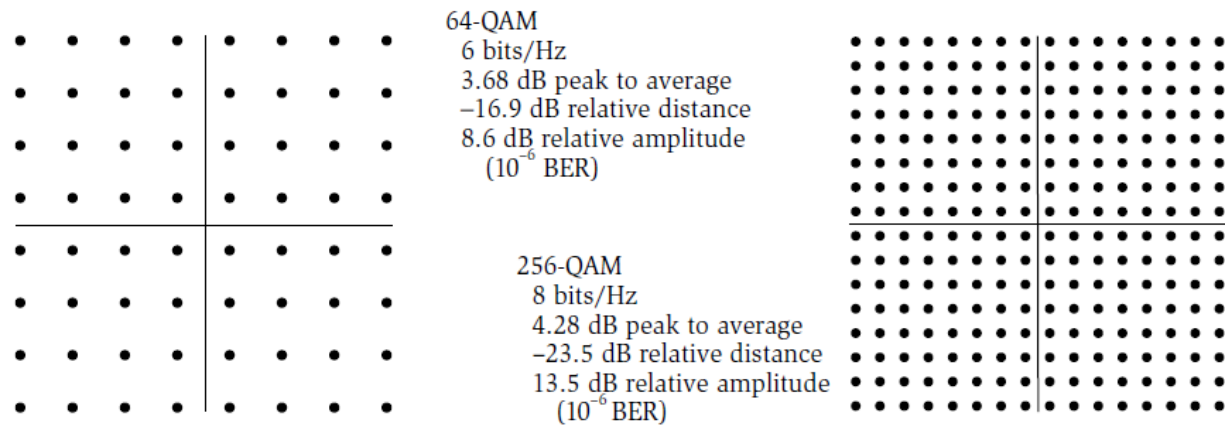
8.2.3. 16-Quadrature Amplitude Modulation (QAM), 64-QAM, and 256-QAM



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

53. 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)

54. 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.*

55. 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

56. 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].

57. Cable television RF receivers concurrently receive RF signals for multiple digital television channels allocated in the RF frequency spectrum of 550

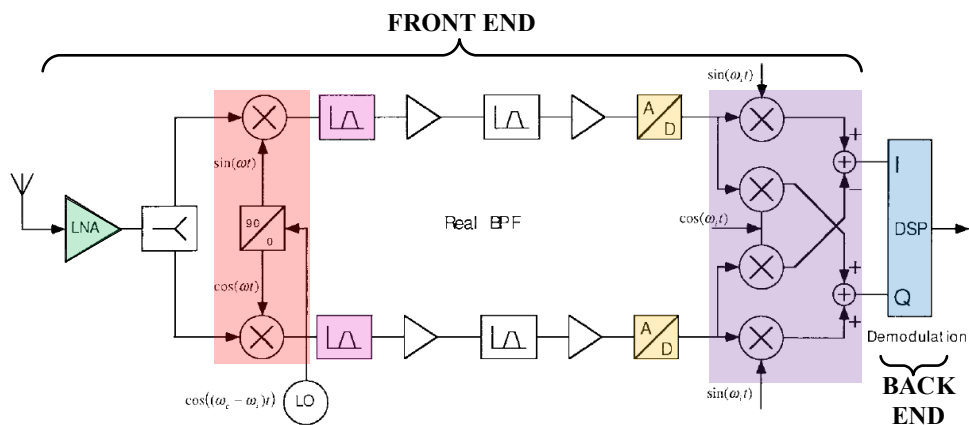
to 862 MHz. Ex. 1033 at 413, 503; Ex. 1037, [0079]-[0080], Fig. 4. Satellite RF receivers concurrently receive RF signals for multiple television channels allocated in the RF frequency spectrum above 950 MHz. Ex. 1035, 1:37-47; Ex. 1037, [0080]. Furthermore, the POSITA was aware that cable and satellite 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.

58. 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 '206 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 '206 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].

59. 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)

60. 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.

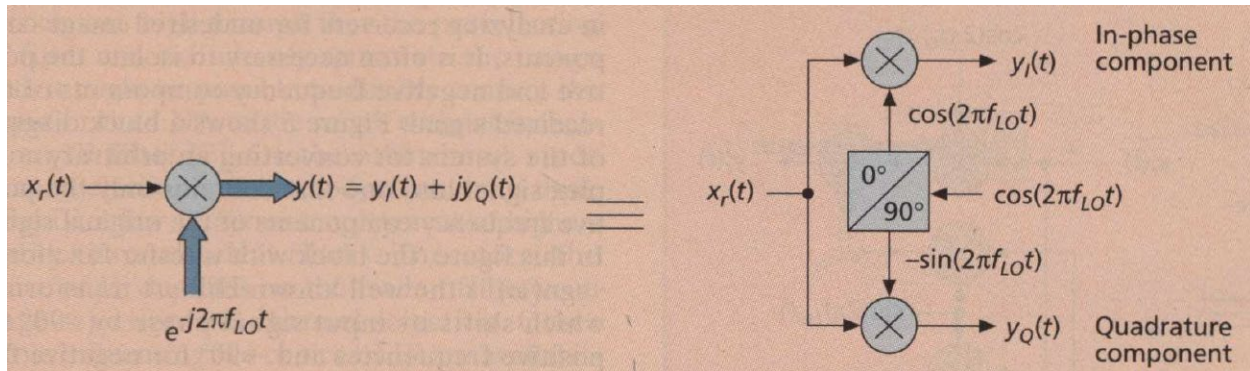
61. Still referring to Figure 22(a) of Ex. 1025 (reproduced and annotated above), in the front end of a low-IF receiver, the incoming RF signals are first amplified by a front-end low noise amplifier (LNA) (**green**) to provide enough gain to boost the received RF signal levels to an acceptable level 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 40-41; 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.

62. 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:

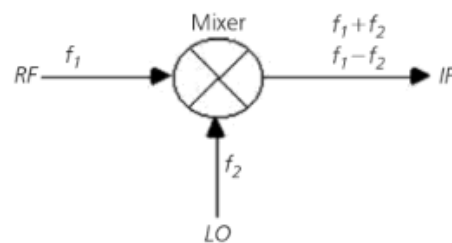
The realization of a multiplier for mixing a real signal with a complex exponential *requires two real multipliers*, as illustrated in Fig. 2. *The real and imaginary parts of the mixer output are called the in-phase (I) and quadrature (Q) components of the downconverted signal (since cosine and sine 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

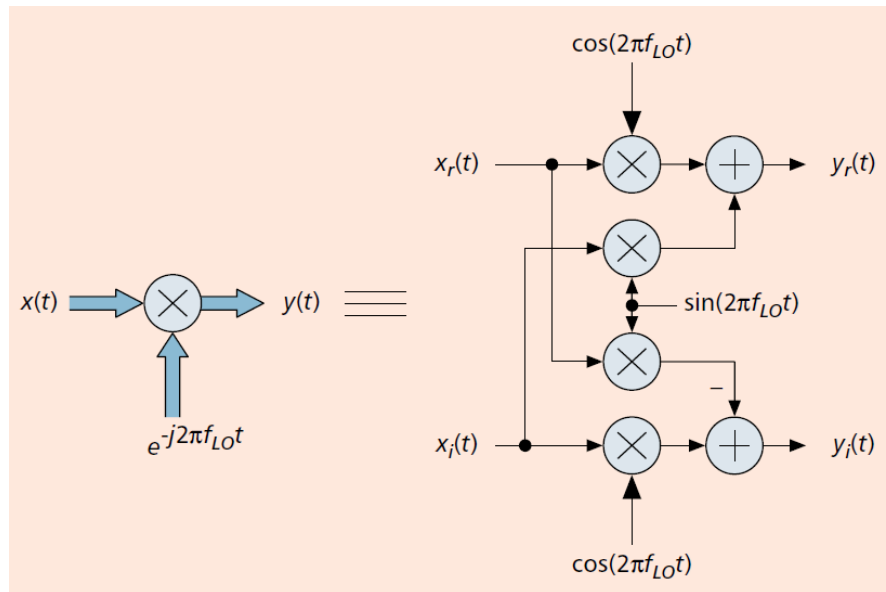
The term “mixer” and “multiplier” are often used interchangeably to refer to an analog or digital electrical circuit (represented by the symbol $\otimes$) that multiplies a modulated input signal (e.g., an RF signal) at frequency f_1 and a reference signal (e.g., from a local oscillator LO) at frequency 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 (page 12)

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

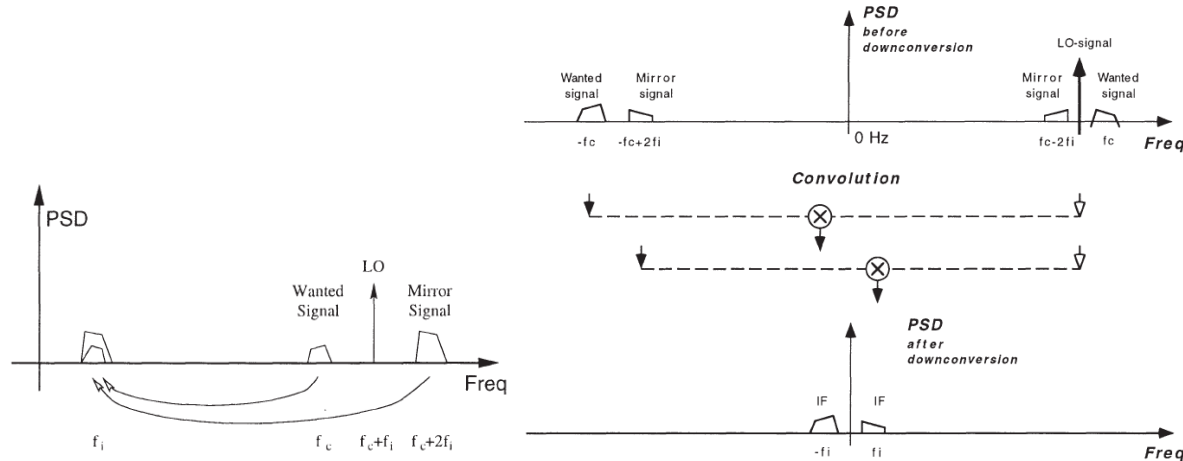
quadrature signals. Ex. 1018 at 133. A complex mixer/multiplier can include two real mixers/multipliers when the input signal is real and the reference signal is complex as shown in Figure 22(a) of Ex. 1025 above, or it can include four real mixers/multipliers if both the input signal and reference signal 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 (Partial Excerpt) (page 134)

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)

63. 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+2f_i 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.

64. 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.

65. 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

66. 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.

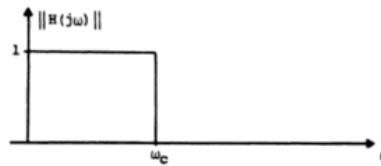


Fig. 1.23. Ideal LP filter magnitude frequency response.

Ex. 1041, Fig. 1.23 (page 14)

- 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.

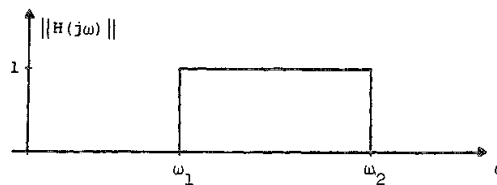


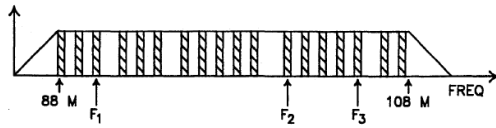
Fig. 1.27. Ideal BP filter.

Ex. 1041, Fig. 1.27 (page 21)

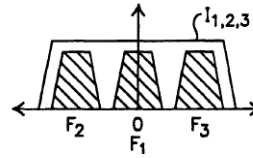
A bandpass filter allows signals within a selected frequency range (e.g., signals for a selected television channel) to be isolated from undesired signals from outside the range. Ex. 1043, 5:13-15; Ex. 1050 at 44. Signals for a desired television channel can also be isolated from signals of undesired 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.

67. 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

68. 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

69. 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

70. 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**).

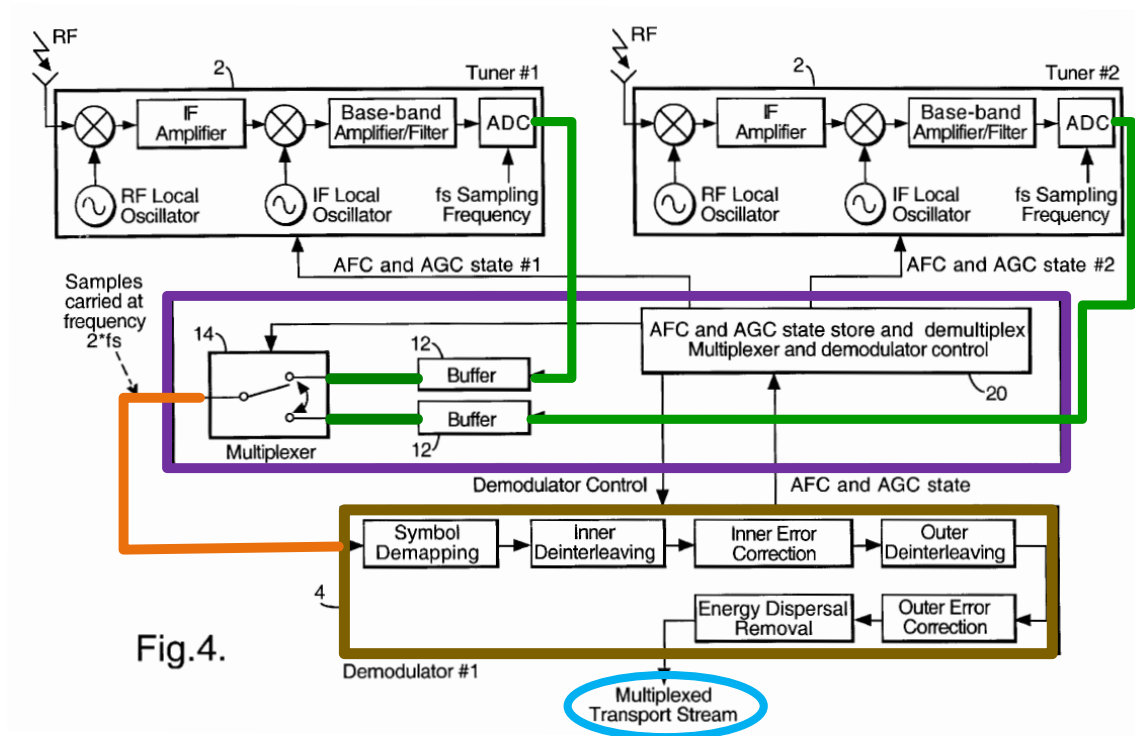


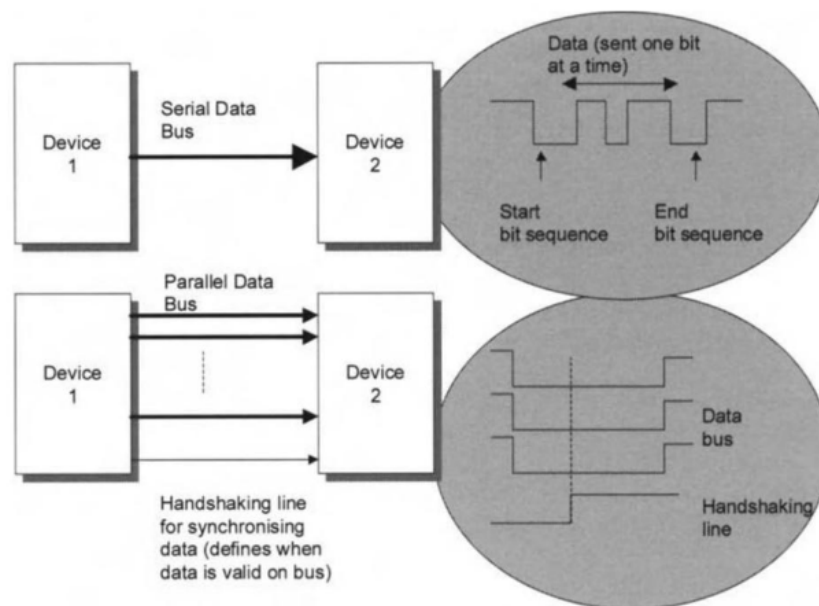
Fig.4.

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

71. 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 '206 patent. It was also known to the POSITA by the earliest claimed priority date (April 17, 2009) of the '206 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)

72. 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.*

73. Therefore, it was well known before the claimed priority date of the ’206 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)

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

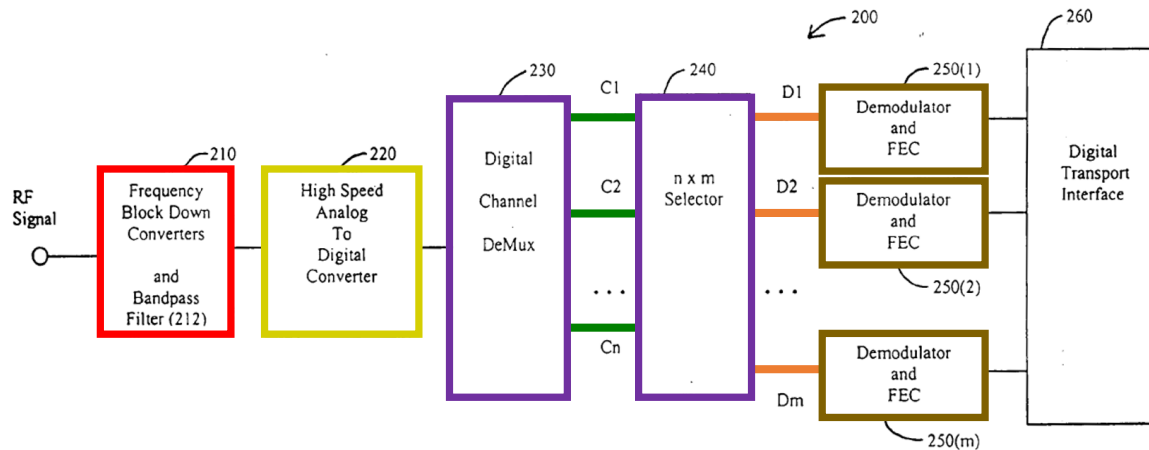


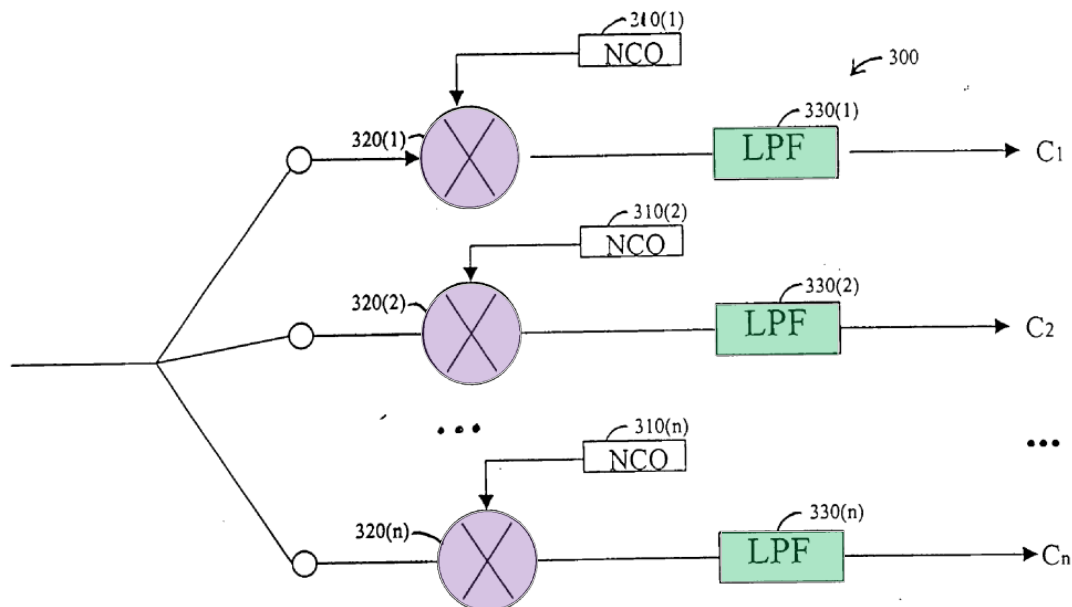
Fig. 2

Ex. 1013, Fig. 2 (annotated)

75. 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. *Id.*, [0010], [0023], [0025], [0027], [0030]-[0037], [0041]-[0042], [0047], claims 1, 4, 9, 31-32. 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

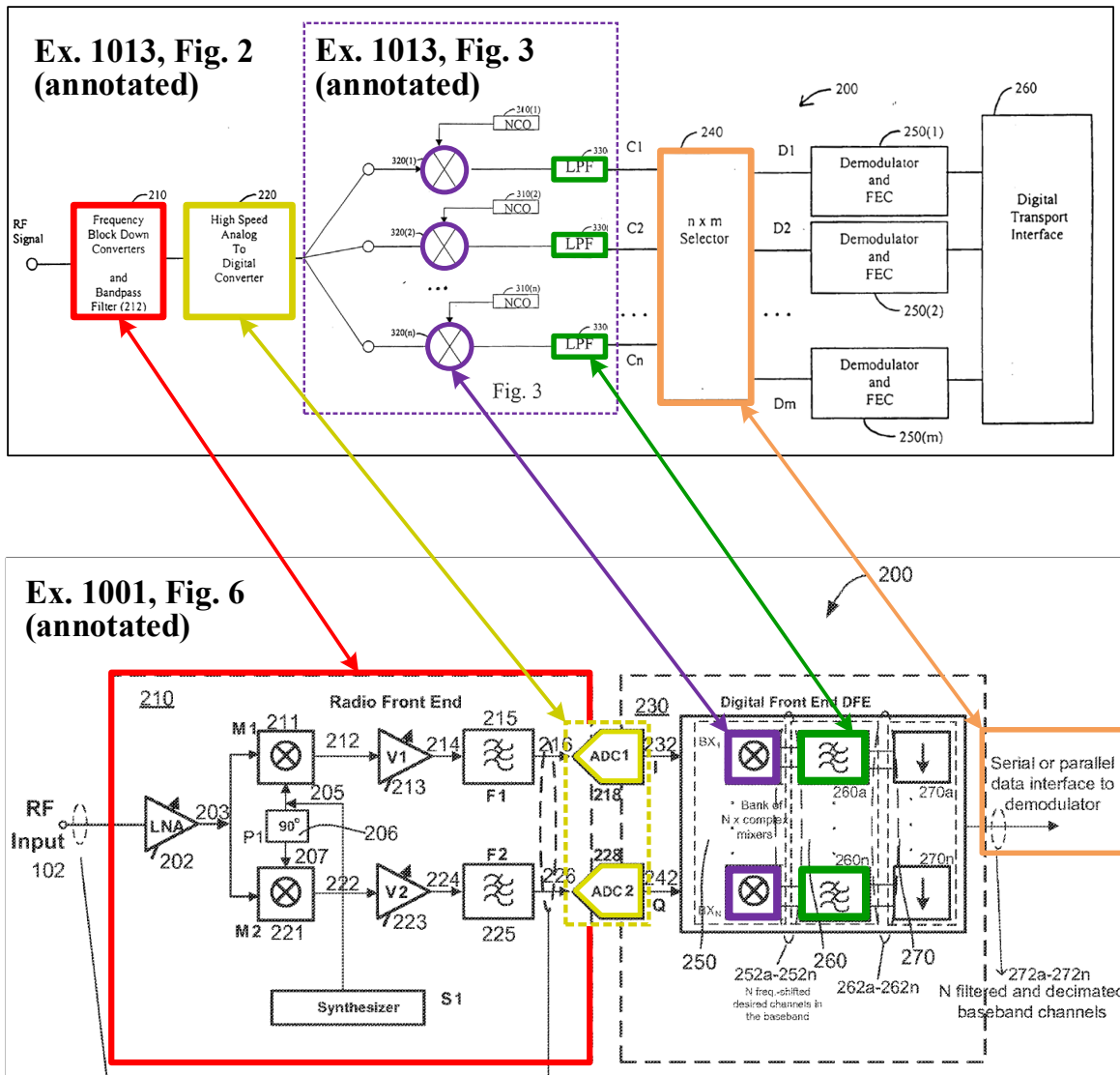
subset of the channels (e.g., D_1 to D_m) to one or more demodulators 250(1), 250(2), . . . 250(m) (**brown**). *Id.*, [0010]-[0011], [0028]-[0029], [0042], [0047], claims 1, 4, 9, 31-32. The demodulators 250(1), 250(2), . . . 250(m) receive and demodulate the selected channels to recover audio and video content. Ex. 1013, [0007].

76. 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 (NCOs) 310(1 . . . n) to shift a target channel within the digital RF signal to be near baseband (0 Hz). Ex. *Id.*, [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 claimed steps implemented with the same system as in the '206 patent. This includes receiving an input signal from a cable network (Element 1B) with a radio front end (**red**), digitizing a contiguous band of frequencies with a “wideband analog-to-digital converter (ADC)” (**gold**) (Element [1C]), concurrently selecting a plurality of desired channels” (**purple/green**) (Element [1D]), and providing the plurality of desired channels via a serial interface (**orange**) (Element [1D]).



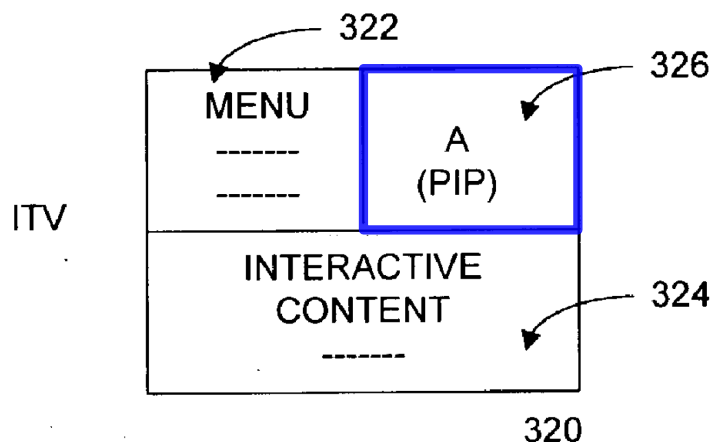
77. It is my opinion that Zhang is in the same field of endeavor as the '206 patent, and thus is analogous art. For example, and like the '206 patent, which “relates to wideband receiver systems and methods having a wideband receiver that is capable of receiving multiple radio frequency channels located in a broad radio frequency spectrum,” Zhang relates to a system and method for “receiv[ing] a multi-channel analog RF signal.” Ex. 1001, 1:27-35; Ex. 1013, [0010], Fig. 2. It is my opinion that Zhang is also reasonably pertinent to problems with which the '206 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 '206 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)

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

79. 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)

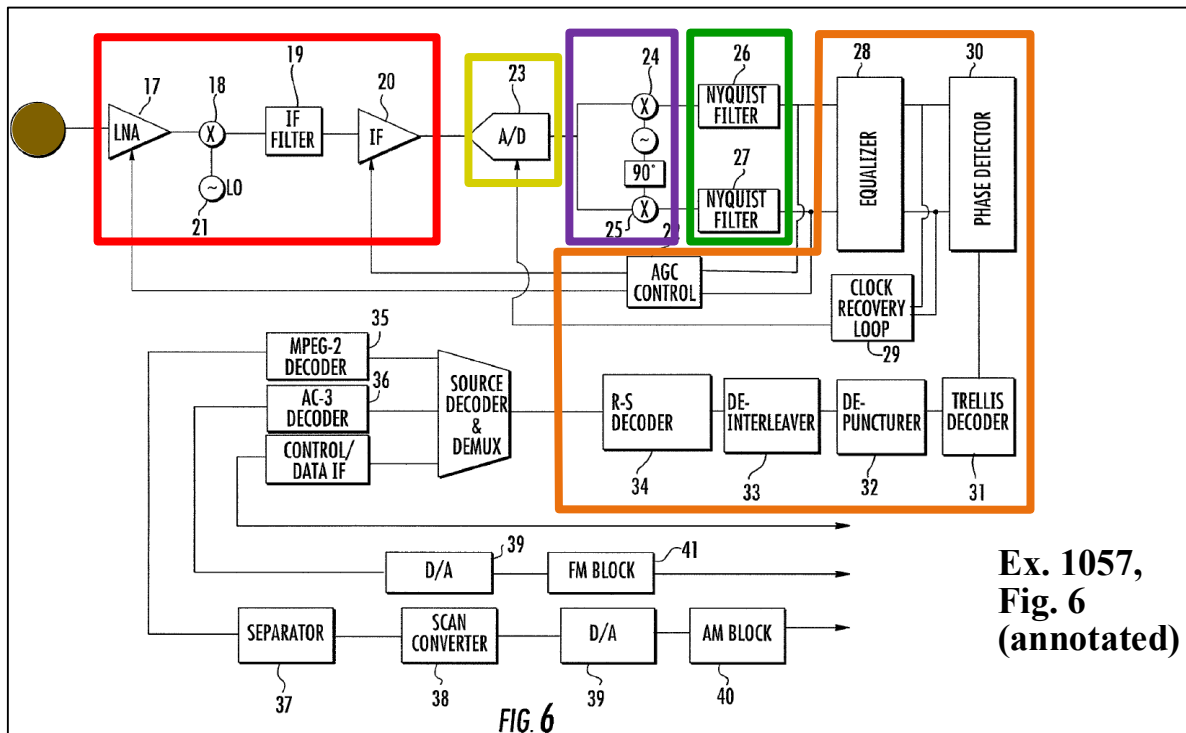
80. It is my opinion that Reisman is in the same field of endeavor as the '206 patent, and thus is analogous art. For example, both Reisman and the '206 patent relate to advanced TV receiver systems. *See*, e.g., Ex. 1001, Abstract, 1:26-34, 2:45-56, Figs, 2, 4, 6; Ex. 1052, Fig. 3 (326), [0073], [0099], [0100], [0248], [0306]. It is also my opinion that Reisman is also reasonably pertinent to problems with which the '206 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 '206 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)

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

82. Jackson discloses a receiver system (similar to the system in Zhang and '206 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**). *Id.*, Figs. 4b, 5-6, [0023]-[0027], claims 1, 8, 12; Ex. 1013, Fig. 2, [0023], [0045].



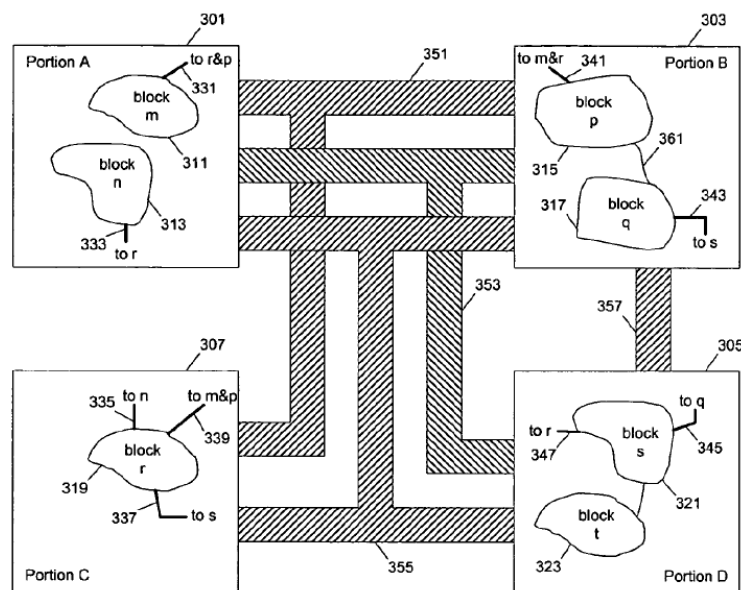
83. It is my opinion that Jackson is in the same field of endeavor as the '206 patent, and thus is analogous art. For example, and like the '206 patent, which relates to downconverting channels to an intermediate frequency and then demodulating those channels, Jackson relates to a television receiver 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 '206 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 '206 patent. 1057, Abstract, [0024]-[0025], claims 4, 11, Figs. 5, 6.

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

84. 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.

85. Pandey teaches a computer aided design technique for digital circuits on a chip (e.g., field programmable gate arrays or application-specific integrated circuits). 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

86. 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. *Id.*, 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. *Id.*, 31:20-22, 32:12-15.

87. It is my opinion that Pandey is reasonably pertinent to problems with which the '206 patent is concerned (as well as to problems with which Zhang is concerned), and is analogous art to the '206 patent (and to Zhang) on at least that basis. The '206 patent describes at length how signals may be processed in digital form. Ex. 1001, 5:33-6:63, Figs. 2-3. Zhang similarly includes such disclosure. Ex. 1013, [0025], [0027]-[0035], [0037]-[0039], [0042], Figs. 2-5. For example, the '206 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 '206 PATENT

9.1. Summary of the Grounds and Comparison of Claim Limitations

88. The '206 patent has 6 independent claims (1, 13, 25, 38, 51, and 64), with 10-12 dependent claims each, for a total of 76 claims. Claims 1, 25, and 51 are nearly identical, with each reciting “receiving an input from a cable network,” “digitizing ... via a wideband analog-to-digital converter ... all received channels that exist in the input signal,” “selecting ... desired channels from the input signal without selecting ... undesired channels,” and “providing the plurality of desired channels.” Claims 1, 25, and 51 only differ based on choice of a single, well-known ancillary feature: “a serial interface” (claim 1), “a digital video recorder” (claim 25), or “a picture-in-picture” display (claim 51).

89. Claims 13, 38, and 64 are also nearly identical, with each reciting “receiving an input signal from a cable network,” “digitizing all received channels in the input signal via a wideband analog-to-digital converter,” and “digitally down

converting each desired channel ... to generate a plurality of digital channel outputs.” Claims 13, 38, and 64 only differ based on the same well-known ancillary features: “a serial interface” (claim 13), “a digital video recorder” (claim 38), or “a picture-in-picture” display (claim 64).

90. Each of the six dependent claim sets corresponding to one of claims 1, 13, 25, 38, 51, and 64 includes claims directed to a common group of well-known features, such as “communicating ... via at least one of an analog amplifier and an analog filter” (claims 2, 14, 26, 39, 52, 65), generating complex signals having I and Q components (claims 3, 15, 27, 40, 53, 66), baseband I and Q complex signal components (claims 4, 16, 28, 41, 54, 67), filtering complex signals (claims 5, 17, 29, 42, 55, 68), demodulating complex signals/desired channels (claims 6/7, 18/19, 30/31, 43/44, 56/57, 69/70), output via a parallel interface (claims 8, 20, 32, 46, 59, 72), a cable broadcast channel (claims 9, 21, 35, 48, 61, 74), and a DOCSIS channel (claims 10, 22, 36, 49, 62, 75).

91. As illustrated in the table below and addressed 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 combination of prior art that disclose or teach the feature.

92. Zhang, the primary reference, discloses every feature of claims 1, 13, 25, and 38, 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, 13, 25, and 38 obvious (ground B). Zhang also discloses every feature of claims 55 and 59, 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 25 and 38 are taught by both Zhang and Reisman, thus both references, and thus grounds A, B, and C apply.

93. 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, 13, 25, and 38 and that do not include “picture-in-picture,” and grounds E and G include Reisman for claims that depend from claims 25, 38, and 55 and 69 or that otherwise include “DVR” or “picture-in-picture.”

94. 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 its teachings regarding a “serial interface” or a “parallel interface.”

95. 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.

Ground	Feature	Claim Groups					
		1-12	13-24	25-37	38-50	51-63	64-76
A/B A/B/C C	A method	1A	13A	25A	38A	51A	64A
	Receiving input signal from cable network	1B	13B	25B	38B	51B	64B
	Receiving input signal from cable network	1C	13C	25C	38C	51C	64C
	Digitizing with wideband ADC						
	Desired and undesired channels						
	Contiguous frequency input						
	Concurrently selecting desired channels without undesired channels	1D		25D		51D	
	Digitally downconverting desired channels		13D		38D		64D

	Providing desired channels	1E	13E	25E	38E	51E	64E
	Via Serial interface	1E	13E				
	DVR			25F	38F		
	PIP					51F	64F
A/B A/B/C C	Generating complex signal I and Q components	3	15	27	40	53	66
	I and Q at baseband	4(3)	16(15)	28(27)	41(40)	54(53)	67(66)
	Filtering complex signal with 6Mhz bandwidth	5(3)	18(15)	31(27)	45(40)	59(53)	73(66)
	Demodulating complex signals	6(3)	19(15)	32(27)	46(40)	60(53)	74(66)
	Demodulating desired channels	7	19	31	44	57	70
	Desired channels comprise a cable broadcast channel	9	21	35	48	61	74
	Desired channel delivered with DOCSIS protocol	10	22	36	49	62	75
	DVR	11	23			63	76
	PIP	12	24	37	50		

	Providing channels via parallel interface			33	46	59	72
	Providing channels via serial interface			36	50	64	78
D D/E E	Cable network connector, analog amplifier, analog filter	2	14	26	39	52	65
	Generating complex signal I and Q components	3	15	27	40	53	66
	I and Q at baseband	4(3)	16(15)	28(27)	41(40)	54(53)	67(66)
	Filtering complex signal with 6Mhz bandwidth	5(3)	18(15)	31(27)	45(40)	59(53)	73(66)
	Demodulating complex signals	6(3)	19(15)	32(27)	46(40)	60(53)	74(66)
F F/G G	Provide demodulated channels via a parallel interface	8(7)	20(19)	32(31)	45(44)	58(57)	71(70)

F	Providing desired	1, 7,	13, 19,				
F/G	channels via serial or	9-	21-	33-34	46-47	59-60	72-73
G	parallel interface	12	24				
H		2-6	14-18				

9.2. Grounds A/B: Zhang

96. In the following, I provide an element-by-element analysis showing how Zhang anticipates (ground A) and renders obvious (ground B) claims 1, 3-7, 9, 11, 13, 15-19, 21, 23, 25, 27-31, 33-35, 38, 40-44, 46-48. 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

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

a. [1A]: “A method for receiving a television (TV) signal comprising:”

98. It is my opinion that Zhang discloses “[a] method for receiving a television (TV) signal comprising:” as claimed.

99. 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 '206 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, 25-26; Section 8.1, *supra*. In my opinion, a POSITA would thus have understood that Zhang’s receiver is “for receiving a television (TV) signal” as recited in Element [1A]. Thus, it is my opinion that Zhang discloses Element [1A].

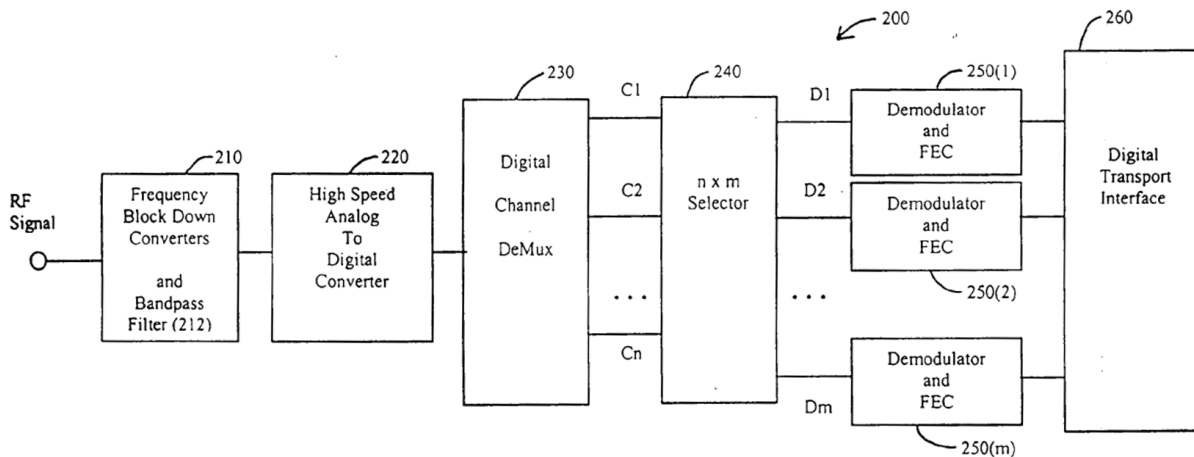


Fig. 2

Ex. 1013, Fig. 2

b. [1B]: “receiving an input signal from a cable network;”

100. It is my opinion that Zhang discloses “receiving an input signal from a cable network,” as claimed.

101. Zhang discloses receiving a “multi-channel analog RF signal” (the claimed “input signal”) from a cable system with a frequency block down converter 210 (red). Ex. 1013, [0005]-[0006], [0023]-[0024], [0041], [0045]-[0047], claims 13, 27, 33. The multi-channel analog RF signal is “an RF signal in a given frequency band that carries multiple RF channels.” Ex. 1013, [0024]. Thus, it is my opinion that Zhang discloses Element [1B].

c. [1C]: “digitizing a contiguous band of frequencies in the input signal via a wideband analog-to-digital converter (ADC), wherein the contiguous band of frequencies comprises all received channels that exist in the input signal and the received channels comprise a plurality of desired channels and a plurality of undesired channels;”

102. It is my opinion that Zhang discloses “digitizing a contiguous band of frequencies in the input signal via a wideband analog-to-digital converter (ADC), wherein the contiguous band of frequencies comprises all received channels that exist in the input signal and the received channels comprise a plurality of desired channels and a plurality of undesired channels,” as claimed.

103. Zhang discloses a Frequency Block Down Converter 210 that “shifts the multi-channel analog RF signal to a lower frequency band,” which is then

digitized by Zhang's ADC 220 (**gold**). Ex. 1013, Abstract, [0010], [0023]-[0025], [0027], [0031], [0034], [0042], [0044]-[0045], Figs. 2, 6-8, claims 1, 8.

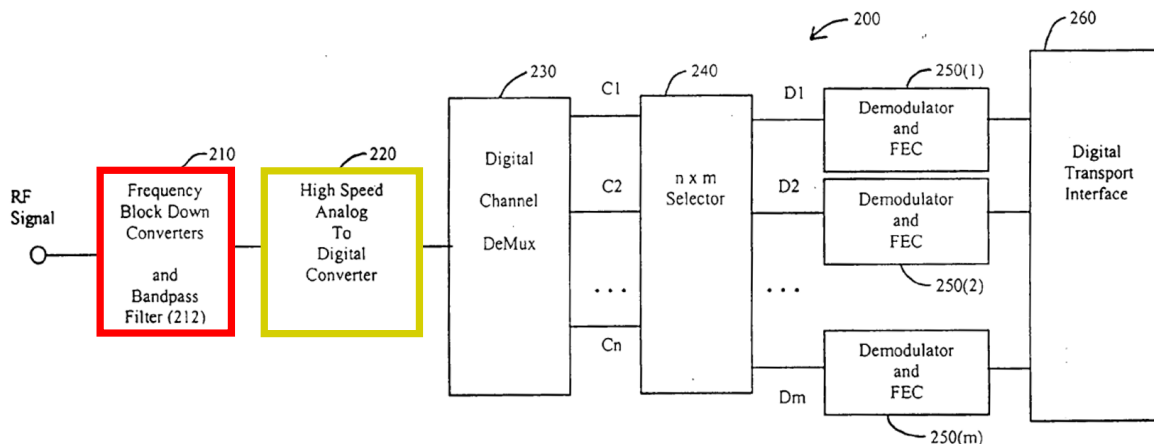


Fig. 2

Ex. 1013, Fig. 2 (annotated)

104. The ADC is “wideband,” because the digitized multi-channel RF signal includes several 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, 1:37-39 (“tuners designed to concurrently receive several TV channels are referred to as wideband tuners”).

105. The RF channels within the multi-channel analog RF signal form “a contiguous band of frequencies” as recited in Element [1C], because when they are shifted by converter 210 “the frequency band of each RF channel and the guard bands remain the same relative to each other,” and because they are spaced next to each other within a frequency band with “precise frequency spacing” (e.g., 6MHz) that is a fraction of the total system bandwidth of the multi-channel RF signal. *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”), 2:52-59 (contiguous channels have spacing “close to each other (e.g. as a fraction of the total system bandwidth). For example, Zhang discloses one example in which a 540-750 MHz frequency band (having a bandwidth of 210MHz) is divided into 35 contiguous channels (35 channels x 6MHz=210MHz frequency band). Moreover, Zhang expressly discloses that in alternate variations of its system, “RF channels need not be contiguous.” Ex. 1013, [0048]. In my opinion, a POSITA would have understood that in the embodiment otherwise described, the RF channels are contiguous. Ex 1013, [0048].

106. Zhang further discloses that ADC 220 is highspeed (e.g., 300MHz, 600MHz) so that it “converts an entire signal band . . . including the multi-channel analog RF signal.” Ex. 1013, claim 8, [0028]. Thus, the digitized frequency band “comprises all received channels that exist in the input signal” as further recited in Element [1C]. *Id.*

107. Moreover, 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.

108. Thus, it is my opinion that Zhang teaches Element [1C].

d. [1D]: “concurrently selecting each of the plurality of desired channels from the input signal without selecting any of the plurality of undesired channels; and;”

109. It is my opinion that Zhang discloses “concurrently selecting each of the plurality of desired channels from the input signal without selecting any of the plurality of undesired channels,” as claimed.

110. In the Zhang system, the multi-channel digital RF signal is input to Demultiplexer 230 and all or a portion of Digital Selector 240 (collectively purple), which perform Element [1D]. Ex. 1013, [0028], Fig. 2 (annotated below).

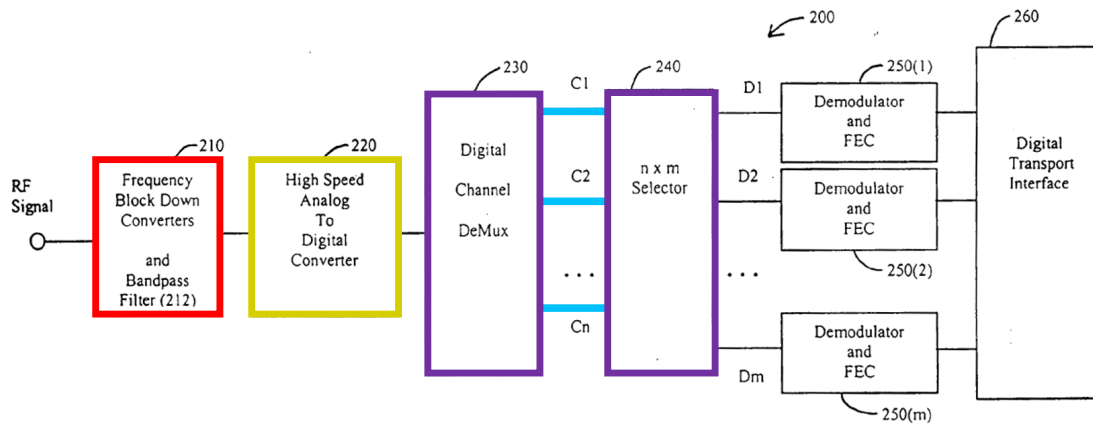


Fig. 2

Ex. 1013, Fig. 2 (annotated)

111. Referring to the annotated figures below, Digital tuner 300 (an embodiment of Digital Channel Demultiplexer 230) (below left), which has the same or equivalent structure as the '206 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 (low-pass filters 330), [0030]-[0034], claims 34, 36-37 with Ex. 1001, Fig. 2 (filters 260), 6:3-26. Like the '206 patent's digital front end, each path of Zhang includes a complex multiplier 320 (purple) followed by a low-pass filters 330 (green).

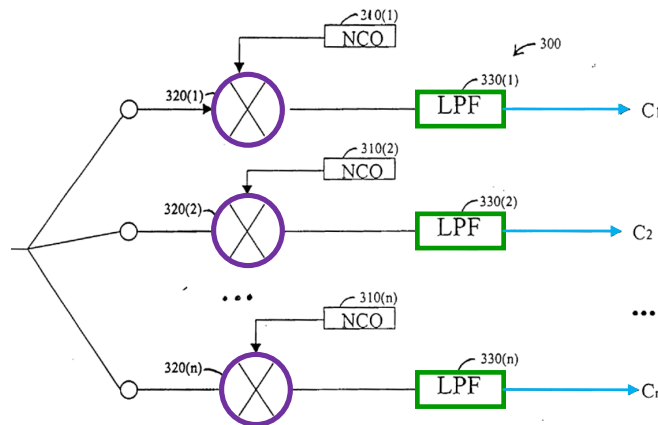
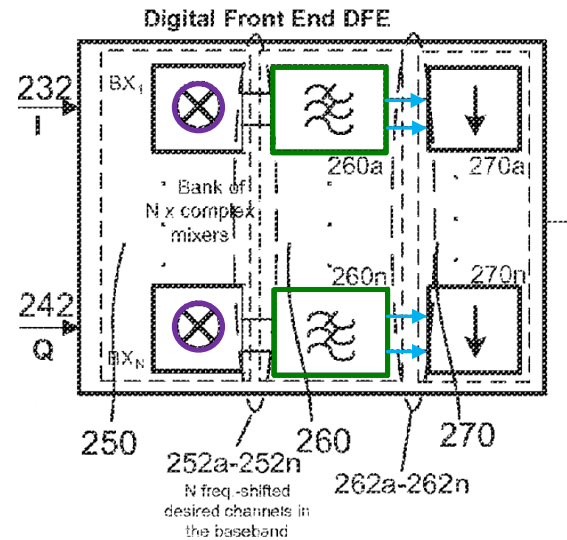


Fig. 3

Ex. 1013, Fig. 3 (annotated)



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

112. 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 lowpass 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.

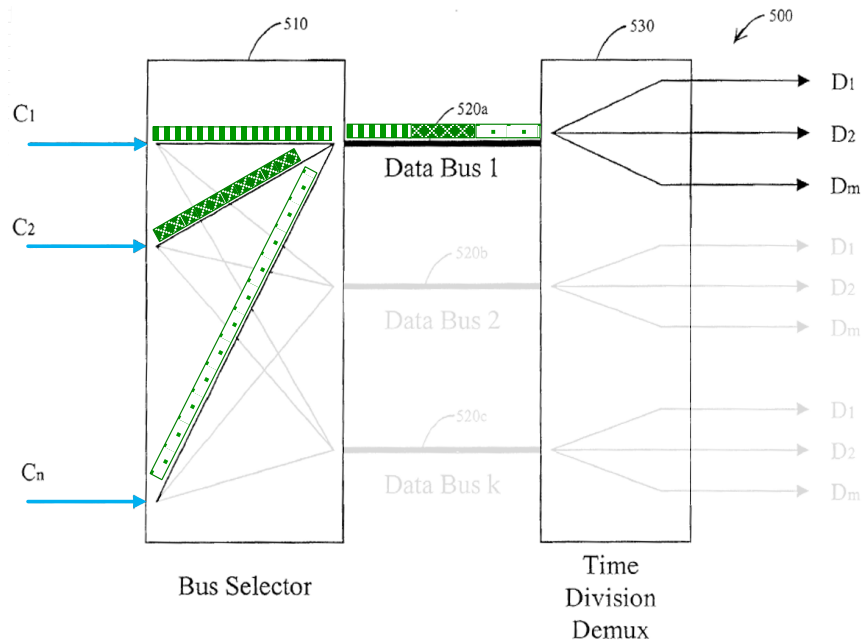
113. Collectively, Digital Channel Demultiplexer 230 and Digital Selector 240 output only user selected channels (either all or a subset of the user selected “C” channels) and filter out all other channels from the digitized multi-channel RF signal. Ex. 1013, [0028], [0039], [0047], claims 2, 30, 32. 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.” Ex. 1013, [0028].

114. Zhang thus discloses “concurrently selecting each of the plurality of desired channels from the input signal without selecting any of the plurality of undesired channels,” as recited in Element [1D].

e. [1E]: “providing the plurality of desired channels via a serial interface.”

115. It is my opinion that Zhang discloses “providing the plurality of desired channels via a serial interface,” as claimed.

116. Digital Selector 240 further provides the desired channels “via 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)

117. In my opinion, 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 (Fig. 6-25); Ex. 1017 at 354-355; Ex. 1048 at 16; Ex. 1049, 1:10-40; *see* Section 8.4, *supra*.

118. 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 (Fig. 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 (Fig. 6-25); Ex. 1015 at 6, 8.

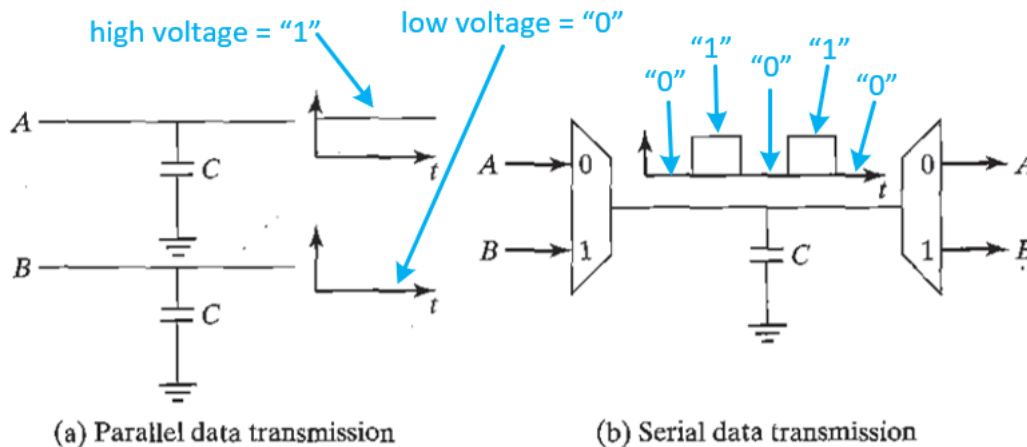


Figure 6-25 Parallel versus time-multiplexed data busses.

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

119. In my opinion, and 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.

120. To the extent that the 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 circuits designs implemented in CMOS (the technology used in Zhang) at the time. Ex. 1014, 30:31-42, 31:15-22; Ex. 1015 at 8; Ex. 1016 at 79-80; Ex. 1017 at 354-355. Indeed, as the '206 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. 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. Further, Zhang discloses that its circuit may be implemented in CMOS, which as was discussed above with respect to 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 (Fig. 6-25). A POSITA implementing the Zhang circuit in CMOS, 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, in my opinion 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.

121. Thus, for the above reasons, it is my opinion that Zhang teaches Element [1E].

9.2.2. Independent Claim 13

122. The elements of claim 13 appear in the Claims Listing Appendix, labeled as elements [13A]-[13E]. It is my opinion that claim 13 is anticipated and rendered obvious by Zhang.

a. [13A]: “A method comprising:”

123. It is my opinion that Zhang discloses “[a] method comprising:” as claimed.

124. Element [13A] is similar to Element [1A], and disclosed by Zhang for the same reasons discussed above with respect to Element [1A]. *See* Section 9.2.1.a.

b. [13B]: “receiving an input signal from a cable network;”

125. It is my opinion that Zhang discloses “receiving an input signal from a cable network,” as claimed.

126. Element [13B] is similar to Element [1B], and disclosed by Zhang for the same reasons discussed above with respect to Element [1B]. *See* Section 9.2.1.b.

- c. **[13C]: “digitizing all received channels in the input signal via a wideband analog-to-digital converter (ADC), wherein the received channels comprise a plurality of desired channels and a plurality of undesired channels;”**

127. It is my opinion that Zhang discloses “digitizing all received channels in the input signal via a wideband analog-to-digital converter (ADC), wherein the received channels comprise a plurality of desired channels and a plurality of undesired channels,” as claimed.

128. Element [13C] is substantially identical to Element [1C], and differs only in that Element [13C] lacks a requirement for “all received channel [that exist] in the input signal” to be comprised in “a contiguous band of frequencies.” Element [13C] is disclosed by Zhang for the same reasons discussed above with respect to Element [1C]. *See* Section 9.2.1.c.

- d. **[13D]: “digitally down converting each desired channel, of the plurality of desired channels, to generate a plurality of digital channel outputs; and”**

129. It is my opinion that Zhang discloses “digitally down converting each desired channel, of the plurality of desired channels, to generate a plurality of digital channel outputs,” as claimed.

130. Referring to the annotated figure below, Zhang’s Demultiplexer 230 and Digital Selector 240 (collectively **purple**) perform Element [13D] for the same reasons discussed above that they perform Element [1D]. Ex. 1013, [0028], Fig. 2.

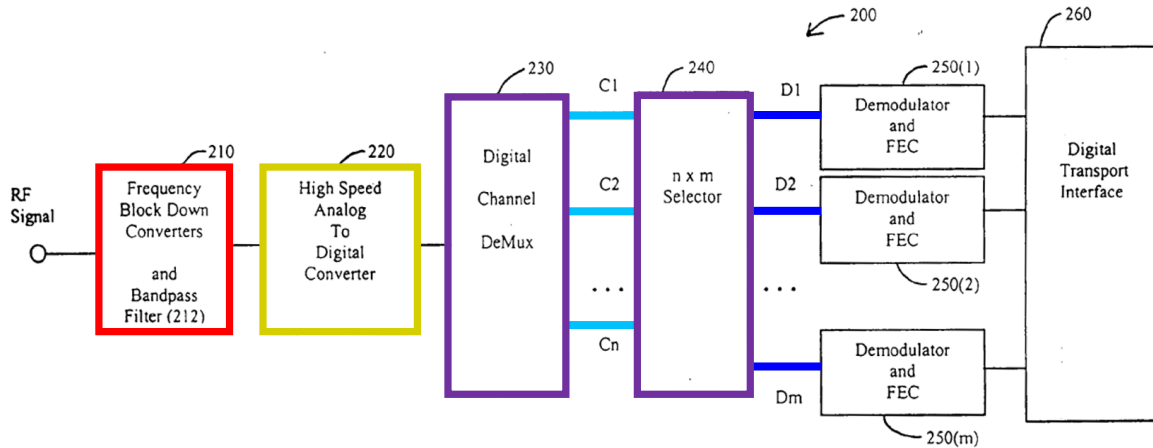


Fig. 2

Ex. 1013, Fig. 2 (annotated)

131. Referring to the annotated figures below, Zhang’s Digital Channel Demultiplexer 230 (below left), which has the same or equivalent structure as the ’206 patent’s digital front end 230 (below right), includes a plurality of signal paths for downconverting a plurality of desired channels $C_1 - C_n$ (**light blue**) selected by the subscriber (the claimed “desired channels”). *Compare* Ex. 1013, Fig. 3 (filters 330), [0030]-[0034], claims 34, 36-37 *with* Ex. 1001, Fig. 2 (filters 260), 6:3-27. Like the ’206 patent’s digital front end, each path includes a complex multiplier 320 (**purple**) followed by a FIR LPF 330 (**green**).

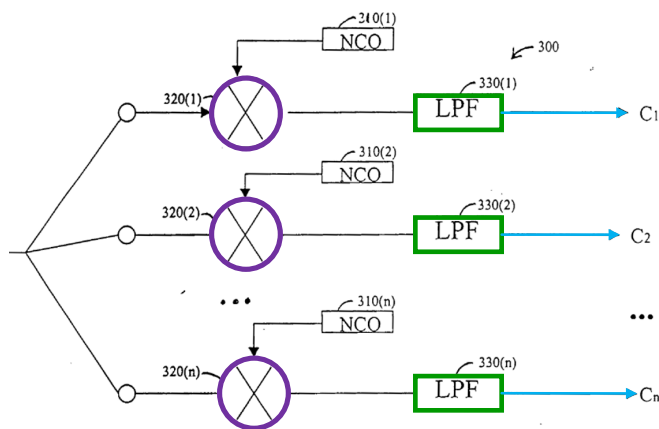
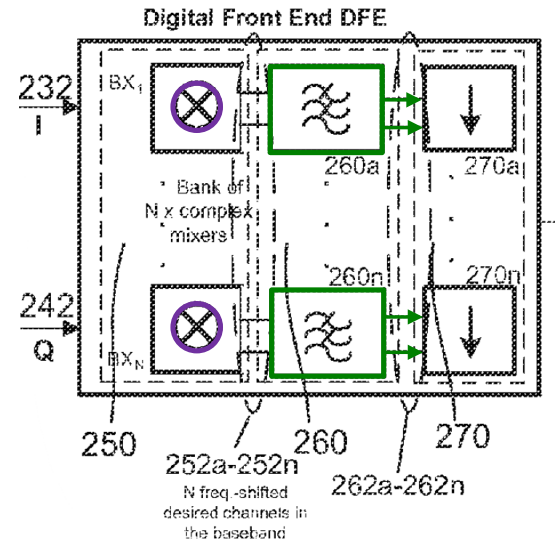


Fig. 3

Ex. 1013, Fig. 3 (annotated)



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

132. Each separate path receives the multi-channel RF signal from ADC 220 and operates in a similar way to down convert one respective desired channel. Ex. 1013, [0031]. In each path, complex multiplier 320 first shifts the frequency of the multi-channel RF signal so that a different “target channel” within the signal is centered at baseband (0 Hz) (i.e., down converting), 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]-[0037] (describing alternative embodiment with polyphase demultiplexer 400), claims 34, 36-37 (“filtering undesired RF channels and passing only the target RF channel”); Ex. 1001, 1:36-39, 7:47-49 (each complex mixer “frequency down-converts signals . . . to an associated

baseband”). Next, Digital Selector 240 provides “m” channels $D_1 - D_m$ (**dark blue**) selected from one or more of channels $C_1 - C_n$ (**light blue**) for demodulation by one or more demodulators. Ex. 1013, [0005], [0028], [0038]-[0039], [0047], claims 2-4, 30, 32. The “D” channels may include all “C” channels (**light blue**), or a subset of those channels. *Id.*

133. Digital Channel Demultiplexer 230 thus performs the Element [13D] step of “digitally down converting ... to generate a plurality of digital channel outputs” where the “outputs” are $C_1 - C_n$ (**light blue**) (or $D_1 - D_m$ (**dark blue**) via Digital Selector 240). Ex. 1013, [0028], [0030]-[0031], [0038]-[0039], [0042], [0047], claims 1-2, 11, 21, 28, 30, 34-37.

134. Thus, Zhang teaches Element [1D].

e. [13E]: “providing the plurality of digital channel outputs via a serial interface.”

135. It is my opinion that Zhang discloses “providing the plurality of digital channel outputs via a serial interface,” as claimed.

136. Element [13E] is substantially identical to Element [1E], differing only in that Element [13E] replaces “desired channels” with “digital channel outputs.” As discussed above, both of these terms refer to the same feature and are disclosed in Zhang as outputs $D_1 - D_m$. *See* Sections 9.2.1 and 9.2.2. Zhang thus discloses Element

[13E] for the same reasons discussed above with respect to Element [1E]. *See* Section 9.2.1.e.

9.2.3. Independent Claim 25

[25A] “A method for receiving a television (TV) signal comprising:”

[25B] “receiving an input signal from a cable network;”

[25C] “digitizing a contiguous band of frequencies in the input signal via a wideband analog-to-digital converter (ADC), wherein the contiguous band of frequencies comprises all received channels that exist in the input signal and the received channels comprise a plurality of desired channels and a plurality of undesired channels;”

[25D] “concurrently selecting each of the plurality of desired channels from the input signal without selecting any of the plurality of undesired channels; and”

[25E] “providing the plurality of desired channels,”

[25F] “wherein the method is performed by a device comprising a digital video recorder (DVR).”

137. The elements of claim 25 appear in the Claims Listing Appendix, labeled as elements [25A]-[25F]. For the following reasons, it is my opinion that claim 25 is anticipated and rendered obvious by Zhang (grounds A and B).

138. Elements [25A]-[25E] are identical to Elements [1A]-[1E], except that Element [25E] does not include the Element [1E] limitation “via a serial interface.” Elements [25A]-[25E] are thus anticipated and rendered obvious by Zhang for the

same reasons discussed above with respect to Elements [1A]-[1E]. *See* Sections 9.2.1.a through 9.2.1.e.

139. It is my opinion that Zhang further discloses Element [25F]. Zhang discloses that its cable TV device as described above with respect to Elements [1A]-[1E] and [25A]-[25E] 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”). In my opinion, 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 25 is thus anticipated (ground A) and rendered obvious (ground B) based on Zhang.

9.2.4. Independent Claim 38

[38A] “A method comprising:”

[38B] “receiving an input signal from a cable network;”

[38C] “digitizing all received channels in the input signal via a wideband analog-to-digital converter (ADC), wherein the received channels comprise a plurality of desired channels and a plurality of undesired channels; and”

[38D] “digitally down converting each desired channel, of the plurality of desired channels, to generate a plurality of digital channel outputs,”

[38E] “wherein the method is performed by a device comprising a digital video recorder (DVR).”

141. The elements of claim 38 appear in the Claims Listing Appendix, labeled as elements [38A]-[38E]. For the following reasons, it is my opinion that claim 38 is anticipated by Zhang (ground A) and rendered obvious by Zhang (ground B).

142. Elements [38A]-[38D] are identical to Elements [13A]-[13D] and directed to substantially the same subject matter as Elements [1A]-[1D] and Elements [25A]-[25D], and thus are disclosed and taught as obvious by Zhang for the same reasons discussed above with respect to Elements [1A]-[1D], Elements [13A]-[13D], and Elements [25A]-[25D]. *See* Sections 9.2.1.a through 9.2.1.d, 9.2.2.a through 9.2.2.d, and 9.2.3.

143. Element [38E] is identical to Element [25F], and thus is taught by Zhang, as described above with respect to Element [25F]. *See* Section 9.2.3.

144. Thus, claim 38 is anticipated and rendered obvious by Zhang (grounds A and B).

9.2.5. Dependent Claims 9, 21, 35, 48

[9/21/35/48] “The method of claim [1/13/25/38], wherein: the plurality of desired channels comprises at least one cable broadcast channel.”

145. It is my opinion that Zhang describes “[t]he method of claim [1/13/25/38], wherein: the plurality of desired channels comprises at least one cable broadcast channel,” as recited in claims 9/21/35/48.

146. Zhang discloses that desired channels are “cable downstream signals” transmitted in a cable system to set-top boxes within a “540-750 MHz” frequency band, and comprise data streams “pre-programmed” by a program provider, and “accessed or used by [plural] subscribers.” Ex. 1013, [0005]-[0007], [0023]-[0024], [0029], [0041], [0045], [0047], claims 13, 27, 33. In general, and as the ’206 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, 1:47-49. 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 and renders obvious (grounds A and B) claims 9, 21, 35, 48 (which depend from claims 1, 13, 25, and 38, respectively).

9.2.6. Dependent Claims 11, 23

[11/23] “The method of claim [1/13], wherein: the method is performed by a device comprising a digital video recorder (DVR).”

148. It is my opinion that Zhang discloses “[t]he method of claim [1/13], wherein: the method is performed by a device comprising a digital video recorder (DVR),” as recited in claims 11/23.

149. Claims 11 and 23 recite the identical limitation as Element [25F], and thus these claims are disclosed and rendered obvious by Zhang (grounds A and B), for the same reasons discussed with respect to their base claims 1 and 13, respectively, and for Zhang’s additional teaching of DVR as described above with respect to Element [25F]. *See* Sections 9.2.1.a through 9.2.1.e, 9.2.2.a through 9.2.2.e, and 9.2.3.

9.2.7. Dependent Claims 33, 46

[33] “The method of claim 25, wherein the method comprises: providing the plurality of desired channels via a parallel interface.”

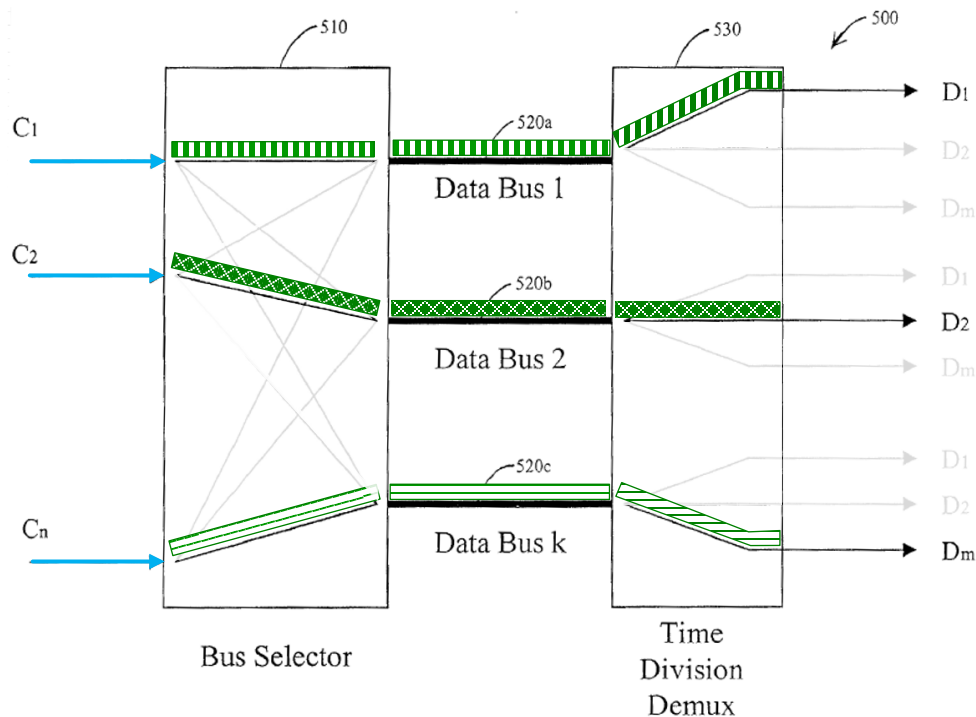
[46] “The method of claim 38, wherein the method comprises: providing the plurality of digital channel outputs via a parallel interface.”

150. It is my opinion that Zhang discloses “[t]he method of claim 25, wherein the method comprises: providing the plurality of desired channels via a parallel interface,” as recited in claims 33, and “[t]he method of claim 38, wherein the method comprises: providing the plurality of digital channel outputs via a parallel interface,” as recited in claims 46.

151. As I discuss above with respect to Elements [1E] and [13E], 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.e and 9.2.2.e. 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 [1E] and [13E]. *Id.*

152. 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 shown in the annotated figure below. *Id.*



Ex. 1013, Fig. 5 (annotated)

153. In my opinion, a POSITA would have understood this arrangement to be a “parallel interface” as recited in claims 33 and 46. Ex. 1013, [0038]-[0039], Fig. 5; Ex. 1014, 30:31-42, 31:15-22; Ex. 1015 at 6; Ex. 1016 at 79-80 (Fig. 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.

154. To the extent that the 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 to a POSITA based on the 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 49-51, 79-80 (Fig. 6-25); Ex. 1017 at 354-355; Ex. 1048, p. 16; Ex. 1049, 1:10-40. Indeed, as the ’206 patent concedes, outputting a digital data stream via a parallel interface was “commonly known,” i.e., Applicant Admitted Prior Art (AAPA). Ex. 1001, 7:10-14.

155. For example (as discussed above with respect to Element [13E]), in my opinion it was well known that digital circuits implemented in CMOS (the technology used in Zhang) transmit data either in parallel or in serial. Ex. 1013, [0044], [0048]; Ex. 1016 at 23, 31-37, 49-51, 80 (Fig. 6-25); Ex. 1015 at 6. *See* Section 9.2.2.e.

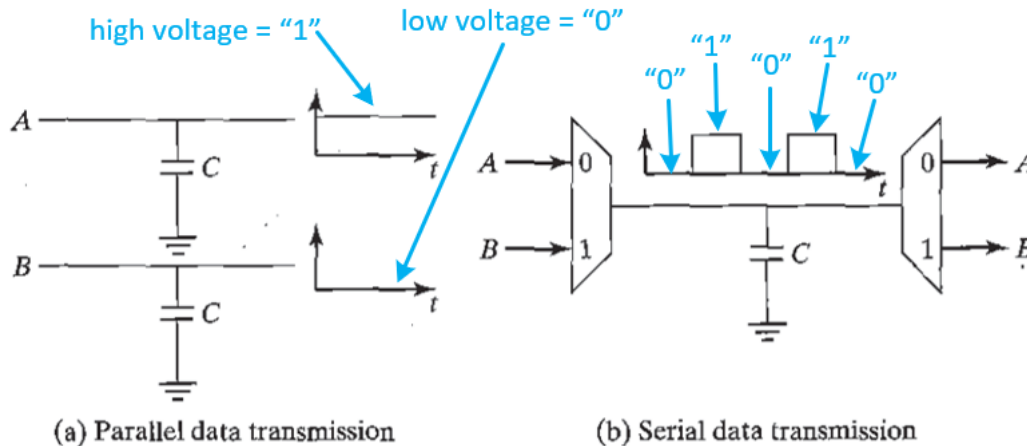


Figure 6-25 Parallel versus time-multiplexed data busses.

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

156. Thus, I understand that 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 by POSITAs 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.

157. Thus, it is my opinion that Zhang's Digital Channel Demultiplexer 230 and Digital Selector 240 anticipate and render obvious (grounds A and B) claims 33 and 46 (depending from claims 25 and 38, respectively).

9.2.8. Dependent Claims 34, 47

[34] “The method of claim 25, wherein the method comprises: providing the plurality of desired channels via a serial interface.”

[47] “The method of claim 38, wherein the method comprises: providing the plurality of digital channel outputs via a serial interface.”

158. It is my opinion that Zhang discloses “[t]he method of claim 25, wherein the method comprises: providing the plurality of desired channels via a serial interface,” as recited in claim 34, and “[t]he method of claim 38, wherein the method comprises: providing the plurality of digital channel outputs via a serial interface,” as recited in claim 47.

159. Claim 34 recites an identical limitation to Element [1E], which recites “providing the plurality of desired channels via a serial interface.” Claim 47 recites an identical limitation to Element [13E], which recites “providing the plurality of digital channel outputs via a serial interface.” As I discuss above, Zhang discloses each of these limitations. *See* Sections 9.2.1.e and 9.2.2.e.

160. Thus, it is my opinion that claims 34 and 47 are anticipated and rendered obvious by Zhang (grounds A and B), for the same reasons discussed as their base claims 25 and 38, respectively, and for Zhang’s additional teaching (alone or with the knowledge of the POSITA) of the serial interface as described with respect to Element [1E] and [13E]. *See* Sections 9.2.1.e, 9.2.2.e, 9.2.3, and 9.2.4.

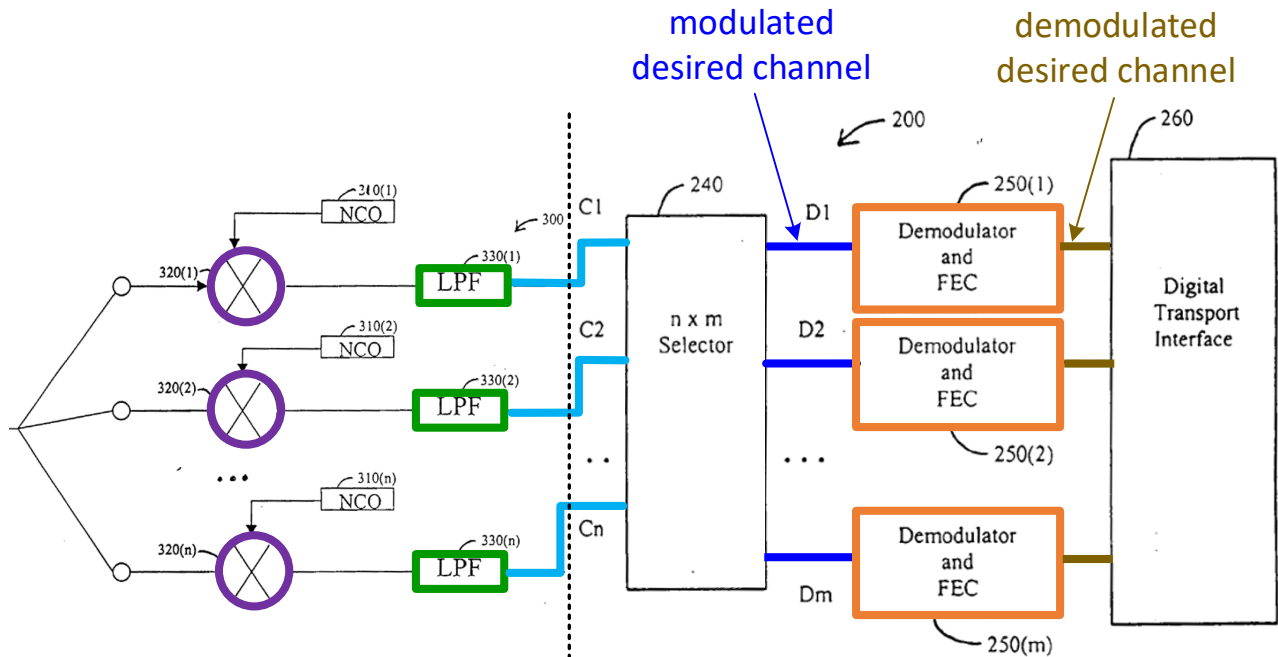
9.2.9. Dependent Claims 7, 19, 31, 44

[7/31] “The method of claim [1/25], wherein the method comprises: demodulating, via each demodulator of a plurality of demodulators, a desired channel, of the plurality of desired channels.”

[19/44] “The method of claim [13/38], wherein the method comprises: demodulating each digitally down converted, desired channel to generate a plurality of demodulated channels.”

161. It is my opinion that Zhang discloses “[t]he method of claim [1/25], wherein the method comprises: demodulating, via each demodulator of a plurality of demodulators, a desired channel, of the plurality of desired channels,” as recited in claims 7/31, and “[t]he method of claim [13/38], wherein the method comprises: demodulating each digitally down converted, desired channel to generate a plurality of demodulated channels,” as recited in claim 19/44.

162. Zhang teaches claims 7, 19, 31, 44. 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. Ex. 1013, [0005], [0011], [0029]-[0031], [0038]-[0039], [0044]-[0047]; *see* Sections 9.2.1.c, 9.2.3.



Ex. 1013, Fig. 3 (annotated)

Ex. 1013, Fig. 2 (annotated)

Ex. 1013, Fig. 2 (annotated)

163. Digital Selector 240 receives modulated desired channels C_1 - C_n (light blue) from the filters 330 (green) and provides only those channels to be demodulated D_1 - D_m (dark blue) to demodulators 250 (orange), which each demodulate one of the desired channels output as demodulated channels (brown). Ex. 1013, [0028]-[0032].

164. Claims 7, 19, 31, and 44 are thus anticipated and rendered obvious by Zhang (grounds A and B), for the same reasons discussed as their base claims 1, 13, 25, and 38, respectively, and for Zhang's additional teaching of demodulators as described above. See Sections 9.2.1, 9.2.2, 9.2.3, and 9.2.4.

9.2.10. Dependent Claims 3, 4, 15, 16, 27, 28, 40, and 41

[3/27] “The method of claim [1/25], wherein the method comprises: generating, via each mixer of a plurality of mixers, a complex signal corresponding to each of the plurality of desired channels, and wherein each corresponding complex signal comprises an in-phase (I) component and a quadrature (Q) component.”

[15/40] “The method of claim [13/38], wherein: digitally down converting comprises generating a corresponding complex signal for each of the plurality of desired channels, and wherein each corresponding complex signal comprises an in-phase (I) component and a quadrature (Q) component.”

[4/16/28/41] “The method of claim [3/15/27/40], wherein: the I and Q components of each corresponding complex signal are at baseband.”

165. 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.

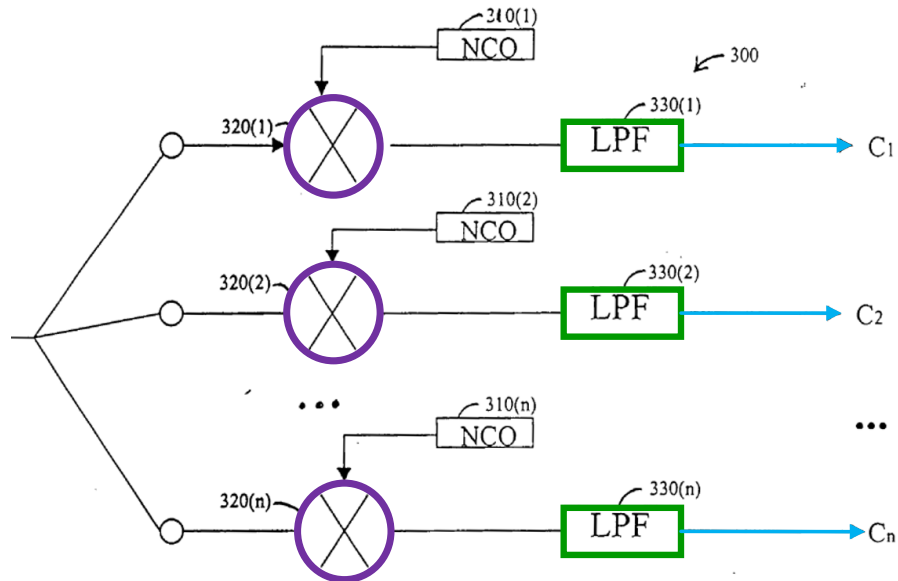


Fig. 3

Ex. 1013, Fig . 3

166. In my opinion, 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, 4:62-63 (“mixers 211 and 221 multiplies (mixes) an amplified RF signal 203 with a respective first oscillator frequency”); *compare* Ex. 1001, 6:6-27 (describing four “multipliers” in complex mixer of Figure 3) *with* Ex. 1001, 9:36-60 (describing four “mixers” in complex mixer in Figure 3); *see also* Ex. 1018 at 133-134 (“frequency downconversion ... is performed by multiplying (mixing) the signal with a sinusoid”), Fig. 1.; *see also* Section 8.3.1, *supra*.

167. Further, as I discuss above (*see* Section 8.3.1, ¶¶ 62-65), 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. 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)).

168. As discussed above with respect to Element [13D], in each path, Zhang’s complex multiplier 320 performs digital down converting by shifting the multi-channel RF signal so that a different “target channel” within the signal is centered at baseband (0 Hz). *See* Section 9.2.2.d; Ex. 1013, [0028], [0031]-[0032], claims 34, 36-37. 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*. Thus, Zhang anticipates (ground A) and renders obvious (ground B) claims 3, 4, 15, 16, 27, 28.

9.2.11. Dependent Claims 5, 17, 29, and 42

[5/29] “The method of claim [3/27], wherein the method comprises: filtering, via each filter of a plurality of filters, the corresponding complex signal, and wherein each corresponding complex signal comprises a 6 MHz channel.”

[17/42] “The method of claim [15/40], wherein the method comprises: a filtering the corresponding complex signal, wherein a bandwidth of the complex signal is 6 MHz.”

169. It is my opinion that Zhang anticipates and renders obvious “[t]he method of claim [3/27], wherein the method comprises: filtering, via each filter of a plurality of filters, the corresponding complex signal, and wherein each corresponding complex signal comprises a 6 MHz channel,” as recited in claims 5/29, and “[t]he method of claim [15/40], wherein the method comprises: a filtering the corresponding complex signal, wherein a bandwidth of the complex signal is 6 MHz,” as recited in claims 17/42.

170. Zhang discloses filters 330 (**green**) that, as described above with respect to claim 3, 15, 27, and 40, filtering of the complex signal output 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]; Ex. 1057, Fig. 6, [0025]. Zhang also discloses that each channel's bandwidth is 6MHz. Ex. 1013, [0006]; Ex. 1057, Fig. 6, [0002], [0026]. Thus, Zhang anticipates (ground A) and renders obvious (ground B) claims 5, 17, 29, and 42.

9.2.12. Dependent Claims 6, 18, 30, and 43

[6/30] “The method of claim [3/27], wherein the method comprises: demodulating, via each demodulator of a plurality of demodulators, the corresponding complex signal to generate a demodulated signal as a desired channel output.”

[18/43] “The method of claim [15/40], wherein the method comprises: demodulating the corresponding complex signal to provide a demodulated channel as a digital channel output.”

171. It is my opinion that Zhang anticipates and renders obvious “[t]he method of claim [3/27], wherein the method comprises: demodulating, via each demodulator of a plurality of demodulators, the corresponding complex signal to generate a demodulated signal as a desired channel output, as recited in claims 6/30, and “[t]he method of claim [15/40], wherein the method comprises: demodulating the corresponding complex signal to provide a demodulated channel as a digital channel output,” as recited in claims 18/43.

172. Claims 6 and 30 recite similar limitations to claims 7 and 31, except that “a desired channel, of the plurality of desired channels” in claims 7 and 31 is replaced in claims 6 and 30 with “the corresponding complex signal to generate a demodulated signal/channel as a desired channel output.” Claims 18 and 43 recite similar limitations to claims 19 and 44, except that “each digitally down converted, desired channel to generate a plurality of demodulated channels” in claims 19 and 44 is replaced in claims 18 and 43 with “the corresponding complex signal to provide a demodulated channel as a digital channel output.” As discussed above with respect to claims 7, 19, 31, and 44 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]. *See* Section 9.2.9. Moreover, as discussed above with respect to claims 3-4, 15-16, 27-28, and 40-41, it is my opinion that 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 9.2.10; Ex. 1018, pp. 133-134. Thus, it is my opinion that Zhang teaches claims 6, 18, 30, and 43.

9.3. Ground C: Zhang/Reisman

9.3.1. Independent Claims 25 and 38 and Dependent Claims 27-31, 33-35, 40-44, and 46-48

[25A] “A method for receiving a television (TV) signal comprising:”

[25B] “receiving an input signal from a cable network;”

[25C] “digitizing a contiguous band of frequencies in the input signal via a wideband analog-to-digital converter (ADC), wherein the contiguous band of frequencies comprises all received channels that exist in the input signal and the received channels comprise a plurality of desired channels and a plurality of undesired channels;”

[25D] “concurrently selecting each of the plurality of desired channels from the input signal without selecting any of the plurality of undesired channels; and”

[25E] “providing the plurality of desired channels,”

[25F] “wherein the method is performed by a device comprising a digital video recorder (DVR).”

[38A] “A method comprising:”

[38B] “receiving an input signal from a cable network;”

[38C] “digitizing all received channels in the input signal via a wideband analog-to-digital converter (ADC), wherein the received channels comprise a plurality of desired channels and a plurality of undesired channels; and”

[38D] “digitally down converting each desired channel, of the plurality of desired channels, to generate a plurality of digital channel outputs,”

[38E] “wherein the method is performed by a device comprising a digital video recorder (DVR).”

173. The elements of claims 25 and 38 appear in the Claims Listing Appendix, labeled as elements [25A]-[25F] and [38A]-[38E], respectively. For the following reasons, it is my opinion that claims 25 and 38 are rendered obvious based on Zhang in view of Reisman (ground C).

174. Elements [25A]-[25E] are identical to Elements [1A]-[1E], except that Element [25E] does not include the Element [1E] limitation “via a serial interface.” Elements [25A]-[25E] are thus taught by Zhang for the same reasons discussed above with respect to Elements [1A]-[1E]. *See* Sections 9.2.1.a through 9.2.1.e.

175. Elements [38A]-[38D] are identical to Elements [13A]-[13D], and thus taught by Zhang for the same reasons discussed above with respect to Elements [13A]-[13D]. *See* Sections 9.2.2.a through 9.2.2.d.

176. As I discuss above, it is my opinion that Zhang further discloses Elements [25F] and [38E] reciting a “DVR.” *See* Sections 9.2.3, and 9.2.4.

177. To the extent that the patent owner argues 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].

178. It is my opinion that a POSITA would have been motivated to include Reisman’s DVR as recited in elements [25F] and [38E] 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 [25A]-[25E] and [38A]-[38D]. 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, by enabling replay and trick-play (fast forward and reverse), and by permitting 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 predicable result (DVR capabilities added to the STB).

179. 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.

180. Thus, it is my opinion that claims 25 and 38 are further rendered obvious based on Zhang in view of Reisman (ground C). For the same reasons, it is also my opinion that Zhang-Reisman render obvious claims 27-31, 33-35, 40-44, 46 and 48, which depend from claims 25 or 38, and which are taught by Zhang as described above. *See* Sections 9.2.5-9.2.12.

9.3.2. Independent Claim 51

[51A] “A method for receiving a television (TV) signal comprising:”

[51B] “receiving an input signal from a cable network;”

[51C] “digitizing a contiguous band of frequencies in the input signal via a wideband analog-to-digital converter (ADC), wherein the contiguous band of frequencies comprises all received channels that exist in the input signal and the received channels comprise a plurality of desired channels and a plurality of undesired channels;”

[51D] “concurrently selecting each of the plurality of desired channels from the input signal without selecting any of the plurality of undesired channels;”

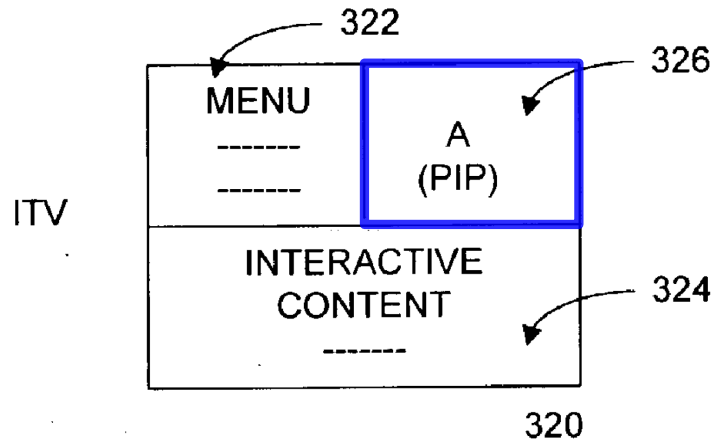
[51E] “providing the plurality of desired channels; and”

[51F] “configuring at least some of the plurality of desired channels as an output for a picture-in-picture display.”

181. The elements of claim 51 appear in the Claims Listing Appendix, labeled as elements [51A]-[51F]. For the following reasons, it is my opinion that claim 51 is rendered obvious by Zhang in view of Reisman (ground C).

182. Elements [51A]-[51E] are identical to Elements [1A]-[1E], except that Element [51E] does not include the Element [1E] limitation “via a serial interface.” Elements [51A]-[51E] are thus taught by Zhang for the same reasons discussed above with respect to Elements [1A]-[1E]. *See* Sections 9.2.1.a through 9.2.1.e.

183. As discussed above with respect to Element [25F], 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)

184. In my opinion, 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 [1A]-[1E]/[51A]-[51E], to allow a user to view different content simultaneously. *See* Sections 9.2.1 and 9.2.3. 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, [0121], [0278], Fig. 3. 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 predicable result (PIP capability in the STB).

185. 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 Figure 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 to 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], [0044]-[0045], *see also Id.*, [0011], [0029]-[0031], [0038]-[0039], [0042]. 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.

186. As such, it is my opinion that claim 51 is rendered obvious based on Zhang in view of Reisman (ground C).

9.3.3. Independent Claim 64

[64A] “A method comprising:”

[64B] “receiving an input signal from a cable network;”

[64C] “digitizing all received channels in the input signal via a wideband analog-to-digital converter (ADC), wherein the received channels comprise a plurality of desired channels and a plurality of undesired channels;”

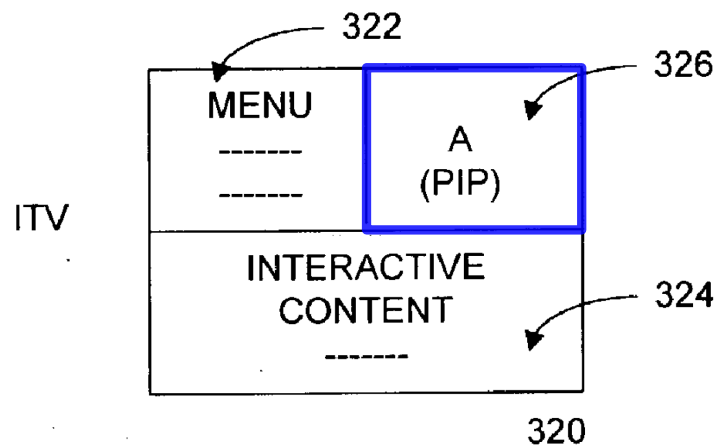
[64D] “digitally down converting each desired channel, of the plurality of desired channels, to generate a plurality of digital channel outputs; and”

[64E] “configuring at least some of the plurality of desired channels as an output for a picture-in-picture display.”

187. The elements of claim 64 appear in the Claims Listing Appendix, labeled as elements [64A]-[64E]. For the following reasons, it is my opinion that claim 64 is rendered obvious by Zhang in view of Reisman (ground C).

188. Elements [64A]-[64D] are identical to Elements [13A]-[13D] and directed to substantially the same subject matter as Elements [1A]-[1C], and thus taught by Zhang for the same reasons discussed above with respect to Elements [1A]-[1C] and Elements [13A]-[13D]. *See* Sections 9.2.1.a through 9.2.a.c and 9.2.2.a through 9.2.2.d, *supra*.

189. As discussed above with respect to Element [51F], Reisman teaches a set-top box “configuring at least some of the plurality of desired channels as an output for a picture-in-picture display.” *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)

190. For the same reasons discussed above, the combination of Zhang in view of Reisman described with respect to Element [51F], also teaches “configuring at least some of the plurality of desired channels as an output for a picture-in-picture display” as recited in Element [64E]. Therefore, Zhang in view of Reisman (ground C) renders claim 64 obvious.

9.3.4. Dependent Claims 9, 21, 35, 48, 61, and 74

[9/21/35/48/61/74] “The method of claim [1/13/25/38/51/64], wherein: the plurality of desired channels comprises at least one cable broadcast channel.”

191. It is my opinion that Zhang describes “[t]he method of claim [1/13/25/38/51/64], wherein: the plurality of desired channels comprises at least one cable broadcast channel,” as recited in claims 9/21/35/48/61/74.

192. Claims 61 and 74 recite the identical limitations as claims 9, 21, 35 and 48. As I have described above, Zhang teaches these limitations. *See* Section 9.2.5. Thus, it is my opinion that claims 61 and 74 are rendered obvious by Zhang in view of Reisman for the reasons I discuss above with respect to their base claims 51 and 64, respectively, and for Zhang’s additional teaching of a cable broadcast channel.

193. It is also my opinion that claims 9, 21, 35, 48, 61, and 74 are 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 [25F], 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]; *see* Sections 9.2.3, 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.

194. 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 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.

195. It is my opinion that the resultant combination of Zhang and Reisman would have been predictable, and that 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.

196. Thus, it is my opinion that claims 9, 21, 35, 48, 61, and 74 are also rendered obvious over Zhang in view of Reisman (ground C) for this further reason.

9.3.5. Dependent Claims 10, 22, 36, 49, 62, and 75

[10/22/36/49/62/75] “The method of claim [1/13/25/38/51/64], wherein: the plurality of desired channels comprises at least one channel delivered via a Data Over Cable Service Interface Specification (DOCSIS) protocol.”

197. It is my opinion that Zhang in view of Reisman discloses “[t]he method of claim [1/13/25/38/51/64], 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 10/22/36/49/62/75.

198. As I discuss above with respect to claims 9, 21, 35, 48, 61, and 74, 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.” *Id.*, [0087]. Reisman also discloses that sourcing base TV or video and enhancements may be by DOCSIS, in which “IP is used within a TV distribution infrastructure.” *Id.*, [0235].

199. 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.”).

200. 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, I understand that 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 straightforward engineering exercise well within the ordinary skillset of a POSITA.

201. As such, it is my opinion that claims 10, 22, 36, 49, 62, and 75 are rendered obvious over Zhang in view of Reisman (ground C).

9.3.6. Dependent Claims 11, 23, 63, and 76

[11/23/63/76] “The method of claim [1/13/51/64], wherein: the method is performed by a device comprising a digital video recorder (DVR).”

202. Claims 11, 23, 63, and 76 recite the identical limitation as Element [25F]. As I discuss above with respect to Element [25F], Reisman discloses this feature, 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 [25F]. *See* Sections 9.3.1, *supra*.

9.3.7. Dependent Claims 12, 24, 37, and 50

[12/37] “The method of claim [1/25], wherein the method comprises: configuring at least some of the plurality of desired channels as an output for a picture-in-picture display.”

[24/50] “The method of claim [13/38], wherein the method comprises: providing a picture-in-picture display signal according to the plurality of digital channel outputs.”

203. It is my opinion that Zhang in view of Reisman disclose “[t]he method of claim [1/25], wherein the method comprises: configuring at least some of the plurality of desired channels as an output for a picture-in-picture display,” as recited in claims 12/37, and “[t]he method of claim [13/38], wherein the method comprises: providing a picture-in-picture display signal according to the plurality of digital channel outputs,” as recited in claims 24/50.

204. Claims 12 and 37 recite the identical limitation as in Elements [51F] and [64F], and claims 24 and 50 are substantially similar. As I discuss above, Reisman discloses these limitations. *See* Sections 9.3.2-3.

205. In my view, claims 12, 24, 37, and 50 are thus taught by Zhang in view of Reisman (ground C) for the same reasons discussed above with respect to their base claims 1, 13, 25, and 38, respectively, and for Reisman’s additional teaching of

PIP as combined with Zhang as described above with respect to Elements [51F] and [64F]. *See* Sections 9.2.1-4 (base claims 1, 13, 25, 38), 9.3.2 (claim 51), 9.3.3.

9.3.8. Dependent claims 53-57, 59, 60, 66-70, 72, and 73

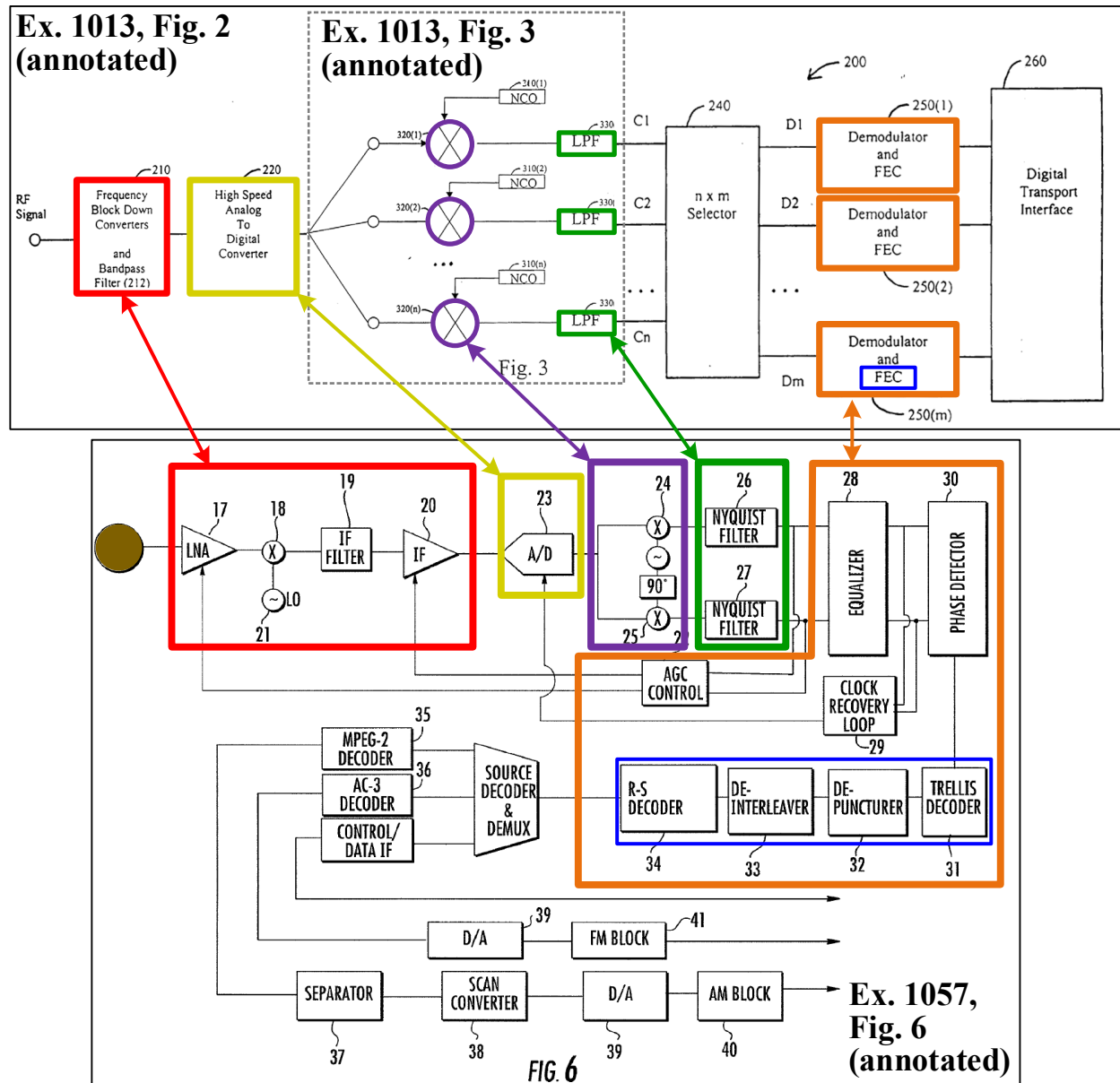
206. Except for depending from different independent claims, claims 53-57, 59, 60, 66-70, 72, and 73 are identical to claims 27-31, 33, 34, 40-44, 46, and 47, respectively. As described above, these limitations are taught by Zhang. *See* Sections 9.2.7-12, *supra*.

207. Zhang-Reisman (ground C) thus renders claims 53-57, 59, 60, 66-70, 72, and 73 obvious for the same reasons discussed above with respect to their base claims 51 and 64, and for Zhang's additional teaching of these limitations of each of these claims.

9.4. Zhang in View of Jackson Render Claims 2-6, 14-18, 26-30, and 39-43 Obvious (Ground D), and Zhang in View of Reisman and Jackson Render Claims 26-30, 39-43, 52-56 and 65-69 Obvious (Ground E)

208. In the following, I provide an element-by-element analysis showing how Zhang in view of Jackson render claims 2-6, 14-18, 26-30, and 39-43 obvious (ground D), and how Zhang in view of Reisman and Jackson render 26-30, and 39-43, 52-56 and 65-69 obvious (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.

209. Jackson discloses in Figure 6 (annotated below) a receiver system for demodulating digitally encoded cable (TV) channels, which has a similar structure to, and performs the same functions as, Zhang's multi-channel demodulator system in Figure 2. Ex. 1057, Fig. 6, [0025]-[0027]; Ex. 1013, Fig. 2, [0023], [0045].



210. 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].

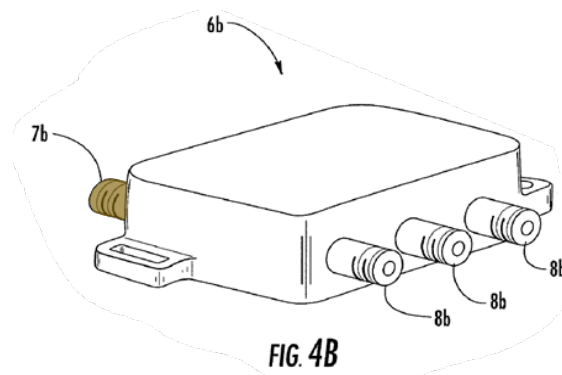
211. It is my opinion that Jackson discloses additional details that teach the elements recited in claims 2-6, 14-18, 26-30, 39-43, 52-56, and 65-69, which a POSITA would have found advantageous for implementing the Zhang (grounds A and B) and Zhang-Reisman (ground C) receivers for the reasons discussed 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, 14, 26, 39, 52, and 65

[2/14/26/39/52/65] “The method of claim [1/13/25/38/51/64], wherein the method comprises: communicating the input signal from a cable network connector to the wideband ADC via at least one of an analog amplifier and an analog filter.”

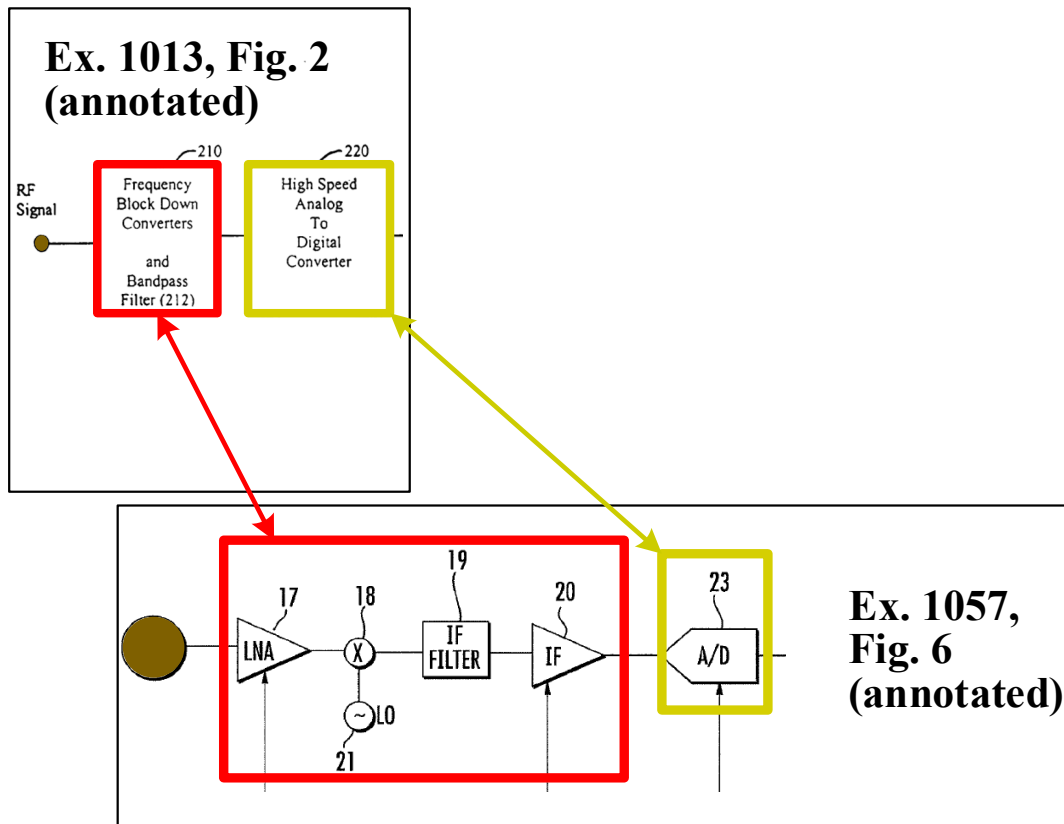
212. It is my opinion that Zhang in view of Jackson disclose “[t]he method of claim [1/13/25/38/51/64], wherein the method comprises: communicating the input signal from a cable network connector to the wideband ADC via at least one of an analog amplifier and an analog filter,” as recited in claims 2/14/26/39/52/65.

213. Both of Zhang’s and Jackson’s systems receive an 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 have also understood to be a “cable network connector.” Ex. 1057, Fig. 4B, [0023], claims 1, 8, 12.



Ex. 1057, Fig. 4B (annotated)

214. 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*. Zhang and Jackson thus disclose the features of claims 2, 14, 26, 39, 52, and 65.



215. In my opinion, 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 7b), 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.

216. In my opinion, this combination of Zhang and Jackson would have been 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].

217. Further, while Zhang discloses that its Frequency Block Down Converter 210 comprises a Bandpass Filter 212, Zhang is silent regarding other aspects of converter 210's implementation. However, in my opinion, 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 at 40-41. It is my opinion that 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 at 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.

218. In my opinion, this combination of Zhang and Jackson would have been 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.

219. Therefore, in my opinion, Zhang in view of Jackson (ground D) renders obvious claims 2, 14, 26, and 39, and Zhang in view of Reisman and Jackson (ground E) renders obvious claims 26, 39, 52 and 65.

9.4.2. Dependent Claims 3, 4, 15, 16, 27, 28, 40, 41, 53, 54, 66, and 67

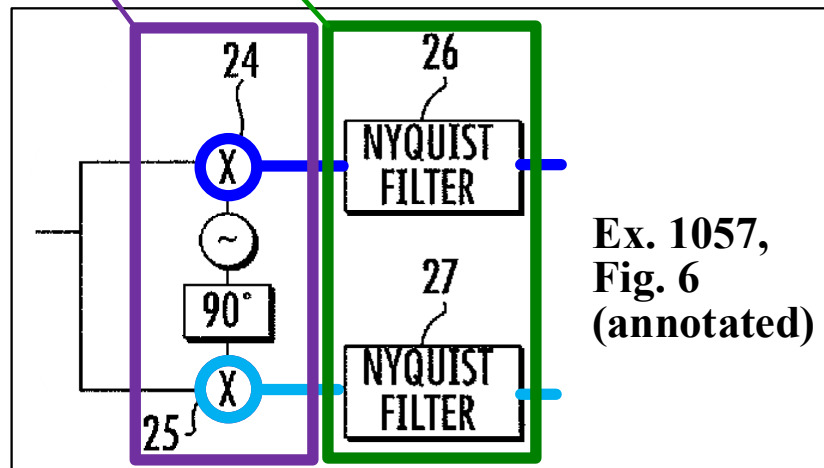
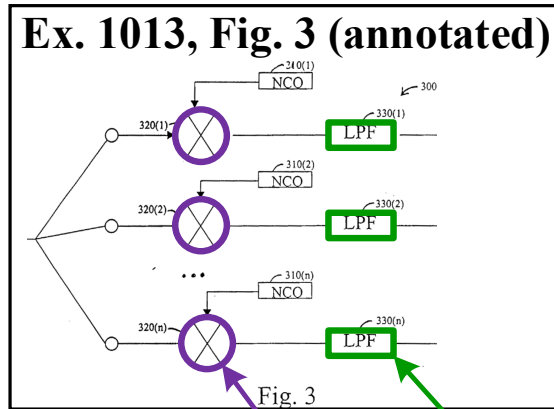
[3/27/53] "The method of claim [1/25/51], wherein the method comprises: generating, via each mixer of a plurality of mixers, a complex signal corresponding to each of the plurality of desired channels, and wherein each corresponding complex signal comprises an in-phase (I) component and a quadrature (Q) component."

[15/40/66] "The method of claim [13/38/64], wherein: digitally down converting comprises generating a corresponding complex signal for each of the plurality of desired channels, and wherein each corresponding complex signal comprises an in-phase (I) component and a quadrature (Q) component."

[4/16/28/41/54/67] "The method of claim [3/15/27/40/53/66], wherein: the I and Q components of each corresponding complex signal are at baseband."

220. 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, 15, 16, 27, 28, 40, and 41, and Zhang-Reisman renders obvious claims, 53, 54, 66, and 67. *See* Sections VII.11, VII.B.8.

221. To the extent Zhang's complex mixers do not teach I and Q outputs, in my opinion 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 in-phase (I) (**dark blue**) and quadrature (Q) (**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, ¶¶ 62-65), 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.



222. 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*.

223. In my opinion, 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).

224. It is also 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.

225. In my opinion, 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 at 279-280; Ex. 1034 at 65-76; Ex. 1018 at 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.

226. Thus, it is my opinion that Zhang in view of Jackson (ground D) renders obvious claims 3, 4, 15, 16, 27, 28, 40, and 41, and that Zhang in view of Reisman and Jackson (ground E) renders obvious claims 27, 28, 40, 41, 53, 54, 66, 67.

9.4.3. Dependent Claims 5, 17, 29, 42, 55, and 68

[5/29/55] "The method of claim [3/27/53], wherein the method comprises: filtering, via each filter of a plurality of filters, the corresponding complex signal, and wherein each corresponding complex signal comprises a 6 MHz channel."

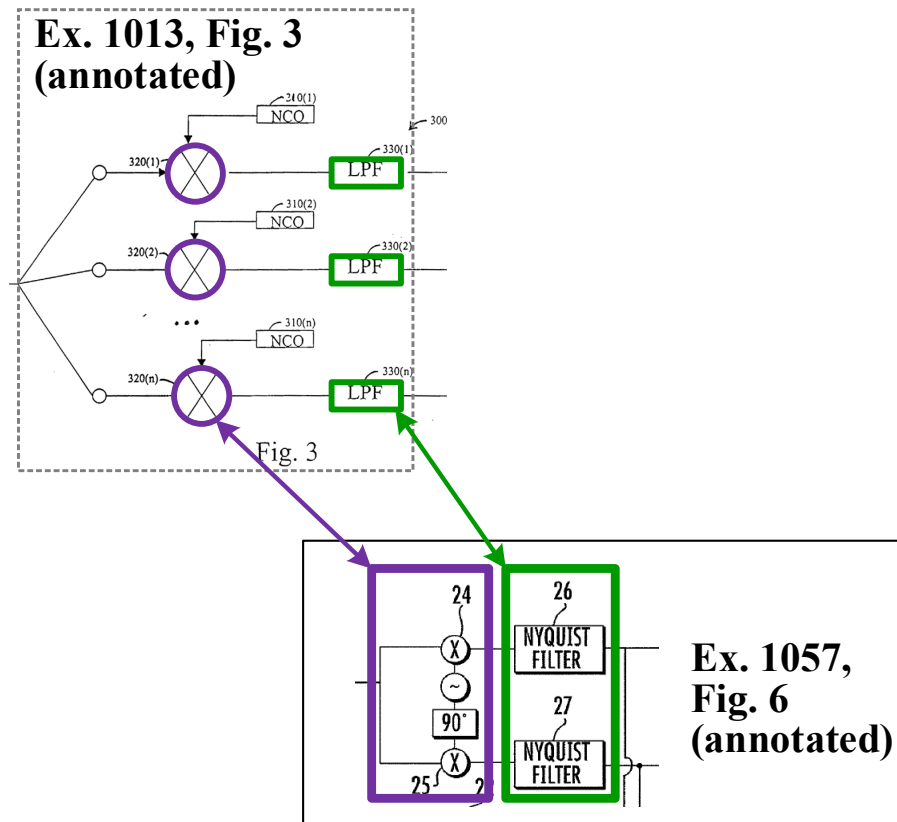
[17/42/68] "The method of claim [15/40/66], wherein the method comprises: a filtering the corresponding complex signal, wherein a bandwidth of the complex signal is 6 MHz."

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

228. 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 method of claim [3/27], wherein the method comprises: filtering, via each filter of a plurality of filters, the corresponding complex signal, and wherein each corresponding complex signal comprises a 6 MHz channel," as recited in claims 5/29, and "[t]he method of claim [15/40], wherein the method comprises: a filtering the corresponding complex signal, wherein a bandwidth of the complex signal is 6 MHz," as recited in claims 17/42. It is also my opinion that each of Zhang in view of Reisman and Jackson (ground E) render obvious "[t]he method of claim 53, wherein the method comprises: filtering, via each filter of a plurality of filters, the corresponding complex signal, and wherein each corresponding complex signal comprises a 6 MHz channel," as recited in claim 55, and "[t]he method of claim 66, wherein the method comprises: a filtering the corresponding complex signal, wherein a bandwidth of the complex signal is 6 MHz," as recited in claim 68.

229. Referring to the annotated figure below, Jackson discloses Nyquist filters 26/27 (**green**) that perform filtering of 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 each channel's bandwidth is 6MHz. Ex. 1057, Fig. 6, [0002] ("Multiple standard digital cable broadcast channels can be transmitted in one such 6 MHz frequency band."), [0026].



230. In my opinion, 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 6MHz selected channels. Ex. 1013, [0006], [0012], [0025], [0030]-[0032], Fig. 3; Ex. 1057, [0002], [0025], Figs. 3, 6.

231. It is my opinion that, as illustrated above, these modifications would have simply involved the one-to-one replacement of Zhang's components with

Jackson's components that perform 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 filters 26/27) for another (Zhang's filters 330) to obtain a predictable result filtering I and Q components of a complex signal). The combination would have been predictable because Jackson's receiver used components that were common and well known to a POSITA, and because the basic architecture of Jackson's receiver matches Zhang's receiver, their implementation was well within the skillset of the POSITA. *See, e.g.*, Ex. 1025 at 279-280; Ex. 1034 at 65-76. Moreover, 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.

232. Thus, it is my opinion that Zhang in view of Jackson (ground D) renders obvious claims 5, 17, 29, and 42, and that Zhang in view of Reisman and Jackson (ground E) renders obvious claims 29, 42, 55 and 68.

9.4.4. Dependent Claims 6, 18, 30, 43, 56, and 69

[6/30/56] "The method of claim [3/27/53], wherein the method comprises: demodulating, via each demodulator of a plurality of demodulators, the corresponding complex signal to generate a demodulated signal as a desired channel output."

[18/43/69] “The method of claim [15/40/66], wherein the method comprises: demodulating the corresponding complex signal to provide a demodulated channel as a digital channel output.”

233. 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. To the extent Zhang’s does not disclose demodulators that demodulate a complex signal, Jackson does.

234. Jackson additionally 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].

235. It is also my opinion that 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. 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 at 279-280; Ex. 1034 at 65-75; Ex. 1018 at 134-139, Figs. 1-3, 6-7, 9-10.

236. Thus, it is my opinion that Zhang in view of Jackson (ground D) renders obvious claims 6, 18, 30, and 43, and that Zhang in view of Reisman and Jackson (ground E) renders obvious claims 30, 43, 56 and 69.

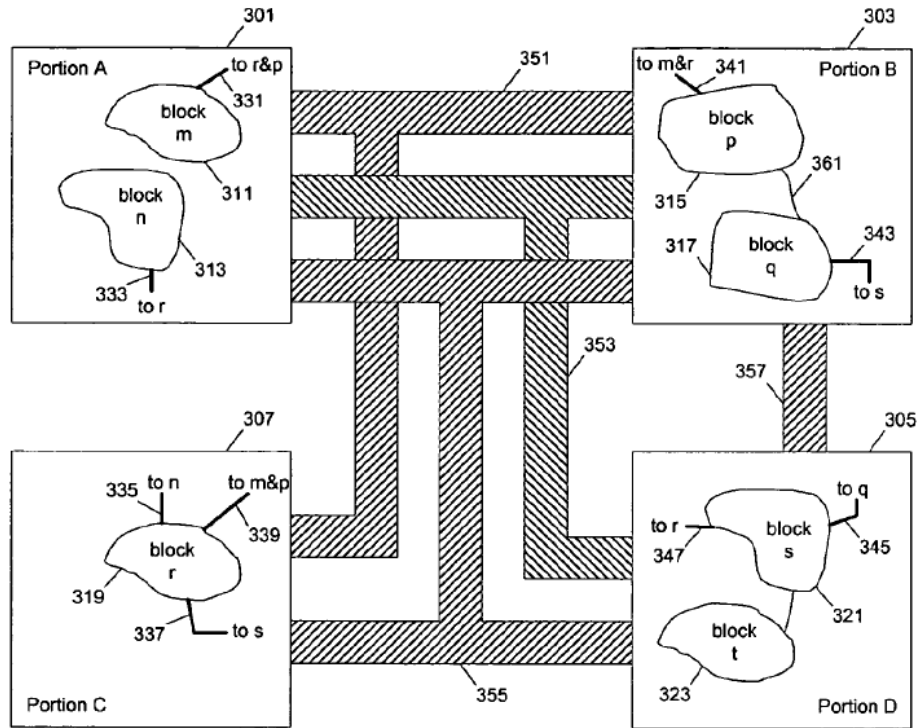
9.5. Ground F: Zhang-Pandey Render (Claims 1, 3-9, 11, 13, 15-21, 23, 32-34, 45-47), and Ground G: Zhang-Reisman-Pandey (Claims 9-12, 21-24, 32-34, 45-47, 58-60, 71-73)

237. It is my opinion that Zhang in view of Pandey (ground F) render obvious claims 1, 3-9, 11, 13, 15-21, 23, 32-34, 45-47, and Zhang I view of Reisman and Pandey (ground G) render obvious claims 9-12, 21-24, 32-34, 45-47, 58-60, 71-73.

9.5.1. Claims 1, 3-7, 9-13, 15-19, 21-24, 33-34, 46-47, 59-60, 72-73

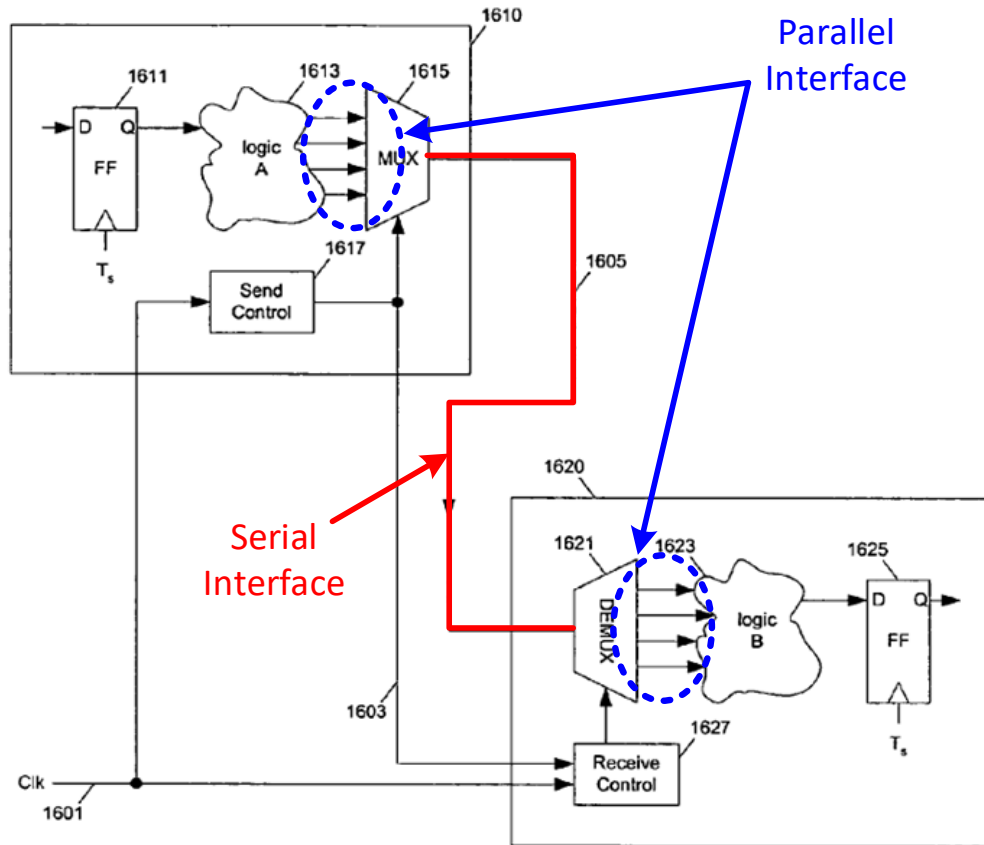
238. As I discuss above, Zhang is cited against various claims above for disclosing a serial interface or a parallel interface. For example, Zhang's Digital Selector 240 is cited for disclosing the claimed "serial interface" in claims 1, 13, 34, 47, 60, and 73 (and claims 3-7, 9-12, 15-19, and and 21-24, which depend from claims 1 or 13), and cited for disclosing the claimed "parallel interface" in claims 33, 46, 59, and 72. *See* Sections 9.2.1.e, 9.2.2.e, 9.2.7, 9.2.8, and 9.3.8. In addition to Zhang teaching serial and parallel interfaces as discussed above with respect to these claims, Pandey also teaches these elements.

239. Pandey teaches creating specific serial and parallel interfaces using 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 involves partitioning functional blocks (such as Zhang's channel demultiplexer 230, digital selector 240, and demodulators 250) to different regions of an integrated circuit chip (e.g., 301, 303, 305, 307) and assigning 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, Figs. 2-3.



Ex. 1014, Fig. 3

240. 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.*

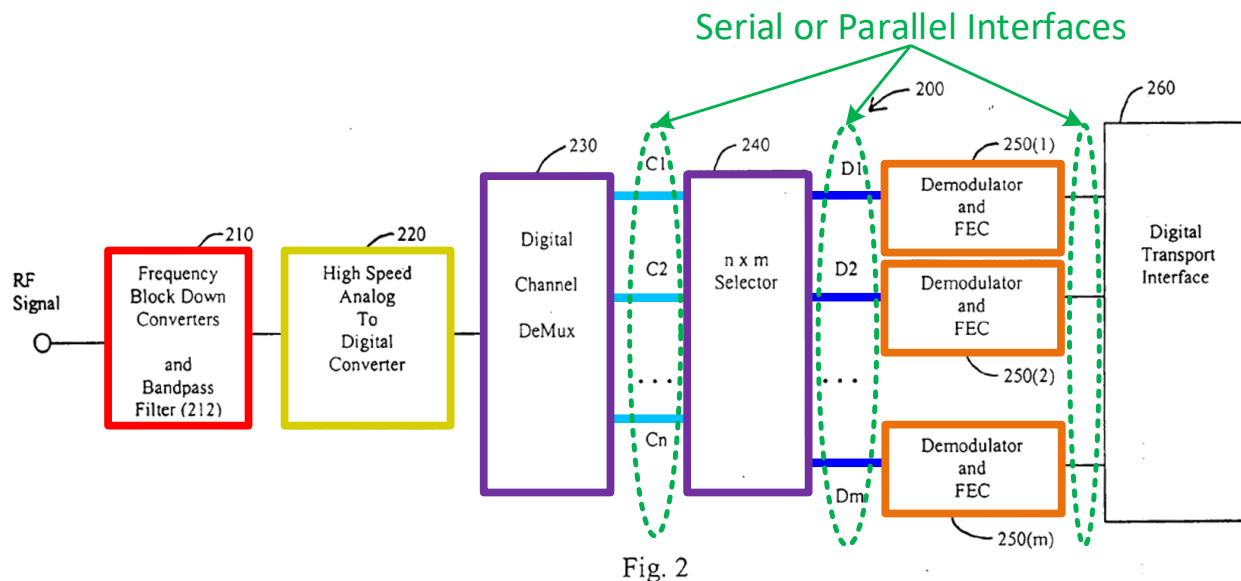


Ex. 1014, Fig. 37

241. 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, 31:56-63, 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 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.

242. In my opinion, it would have been obvious for a POSITA to have applied 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)

243. 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.*

244. 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).

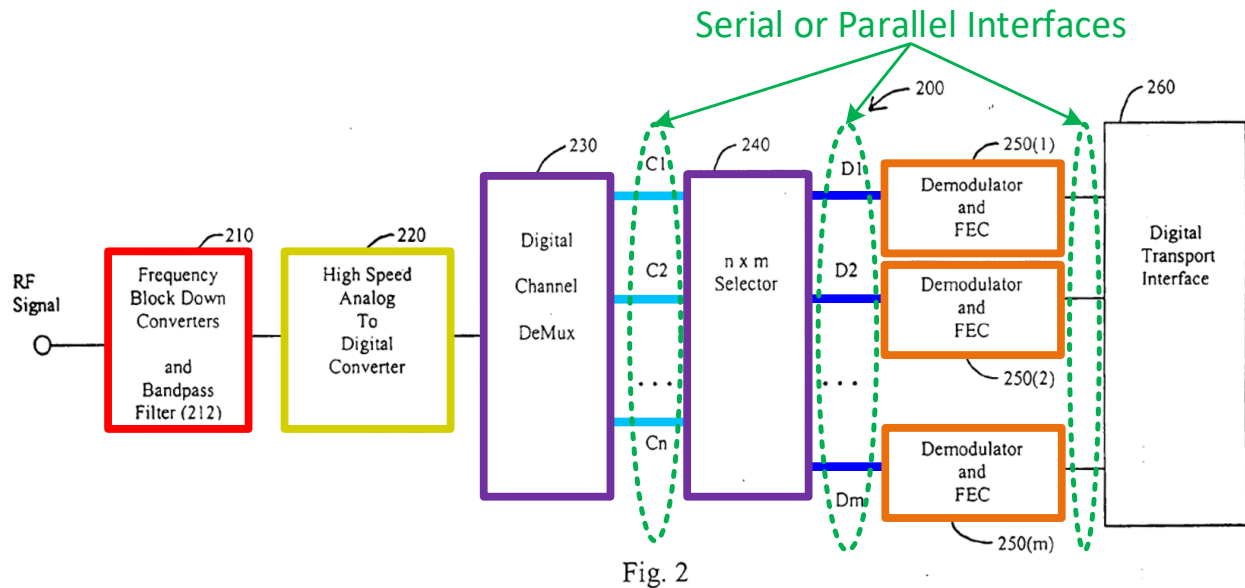
245. A POSITA would have had a reasonable expectation of success in combining Zhang and Pandey, because Pandey's optimization utilized processes such as floor planning, partitioning, and wire routing that were standard and well within a POSITA's skillset. Ex. 1014, 1:20-2:38.

246. Thus, it is my opinion that claims 1, 3-7, 9, 11, 13, 15-19, 21, 23, 33-34, and 46-47 are obvious over Zhang in view of Pandey, and that claims 10, 12, 22, 24, 33-34, 46-47, 59-60, and 72-73 are obvious over Zhang in view of Reisman and Pandey. *See* Sections 9.2.1.e, 9.2.2.e, 9.2.5 through 9.2.12, and 9.3.4 through 9.3.8.

9.5.2. Dependent Claims 8, 20, 32, 45, 58, and 71

[8/20/32/45/58/71] "The method of claim [7/19/31/44/57/70], wherein the method comprises: providing a [or the] plurality of demodulated [desired] channels via a parallel interface."

247. As I discuss above with respect to claims 7, 19, 31, 44, 57, and 70, Zhang teaches providing the demodulated channels at the output of Demodulators 250(1)-250(m), and as discussed in the previous section (9.5.1), the combination of Zhang and Pandey teach that it would have been obvious for Zhang's demodulator outputs to be implemented with a parallel interface as shown below. *See* Sections 9.2.9, 9.3.8 and 9.5.1.



Ex. 1013, Fig. 2 (annotated)

248. Thus, the combination of Zhang and Pandey render obvious claims 8, 20, 32, and 45, and the combination of Zhang, Reisman, and Pandey render obvious claims 32, 45, 58, and 71, for the same reasons discussed above with respect to their base claims 1, 13, 25, 38, 51, and 64, and further based on the additional teachings of Pandey as discussed above. *See* Section 9.5.1.

9.6. Zhang in view Pandey and Jackson Render Claims 2-6 and 14-18 Obvious (Ground H)

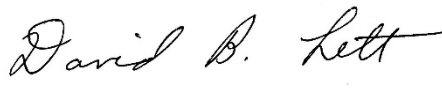
249. As I discuss above for ground D, Jackson teaches certain features of claims 2-6 and 14-18. As I discuss above for ground F, Pandey teaches serial and parallel interfaces of independent claims 1 and 13, from which claims 2-6 and 14-18 depend. Because these features in combination with Zhang are independent from one another, in my opinion it would have been obvious for a POSITA to combine Zhang with Jackson and with Pandey for the reasons discussed above with respect

to grounds D and F. *See* Sections 9.4 and 9.5. Thus, claims 2-6 and 14-18 are taught by the combination of Zhang in view of Jackson, and further in view of Pandey.

10.CONCLUSION

250. 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

CLAIM LISTING APPENDIX
U.S. Pat. No. 11,399,206

Designation	Claim Language
Claim 1	
[1A]	A method for receiving a television (TV) signal comprising:
[1B]	receiving an input signal from a cable network;
[1C]	digitizing a contiguous band of frequencies in the input signal via a wideband analog-to-digital converter (ADC), wherein the contiguous band of frequencies comprises all received channels that exist in the input signal and the received channels comprise a plurality of desired channels and a plurality of undesired channels;
[1D]	concurrently selecting each of the plurality of desired channels from the input signal without selecting any of the plurality of undesired channels; and
[1E]	providing the plurality of desired channels via a serial interface.
Claim 2	
2	The method of claim 1, wherein the method comprises: communicating the input signal from a cable network connector to the wideband ADC via at least one of an analog amplifier and an analog filter.
Claim 3	
[3A]	The method of claim 1, wherein the method comprises: generating, via each mixer of a plurality of mixers, a complex signal corresponding to each of the plurality of desired channels, and
[3B]	wherein each corresponding complex signal comprises an in-phase (I) component and a quadrature (Q) component.
Claim 4	
4	The method of claim 3, wherein: the I and Q components of each corresponding complex signal are at baseband.
Claim 5	
5	The method of claim 3, wherein the method comprises: filtering, via each filter of a plurality of filters, the corresponding complex signal, and wherein each corresponding complex signal comprises a 6 MHz channel.

Designation	Claim Language
Claim 6	
6	The method of claim 3, wherein the method comprises: demodulating, via each demodulator of a plurality of demodulators, the corresponding complex signal to generate a demodulated signal as a desired channel output.
Claim 7	
7	The method of claim 1, wherein the method comprises: demodulating, via each demodulator of a plurality of demodulators, a desired channel, of the plurality of desired channels.
Claim 8	
8	The method of claim 7, wherein the method comprises: providing a plurality of demodulated desired channels via a parallel interface.
Claim 9	
9	The method of claim 1, wherein: the plurality of desired channels comprises at least one cable broadcast channel.
Claim 10	
10	The method of claim 1, wherein: 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 method of claim 1, wherein: the method is performed by a device comprising a digital video recorder (DVR).
Claim 12	
12	The method of claim 1, wherein the method comprises: configuring at least some of the plurality of desired channels as an output for a picture-in-picture display.
Claim 13	
[13A]	A method comprising:
[13B]	receiving an input signal from a cable network;
[13C]	digitizing all received channels in the input signal via a wideband analog-to-digital converter (ADC), wherein the received channels comprise a plurality of desired channels and a plurality of undesired channels;

Designation	Claim Language
[13D]	digitally down converting each desired channel, of the plurality of desired channels, to generate a plurality of digital channel outputs; and
[13E]	providing the plurality of digital channel outputs via a serial interface.
Claim 14	
14	The method of claim 13, wherein the method comprises: communicating the input signal from a cable network connector to the wideband ADC via at least one of an analog amplifier and an analog filter.
Claim 15	
[15A]	The method of claim 13, wherein: digitally down converting comprises generating a corresponding complex signal for each of the plurality of desired channels, and
[15B]	wherein each corresponding complex signal comprises an in-phase (I) component and a quadrature (Q) component.
Claim 16	
16	The method of claim 15, wherein: the I and Q components of each corresponding complex signal are at baseband.
Claim 17	
17	The method of claim 15, wherein the method comprises: a filtering the corresponding complex signal, wherein a bandwidth of the complex signal is 6 MHz.
Claim 18	
18	The method of claim 15, wherein the method comprises: demodulating the corresponding complex signal to provide a demodulated channel as a digital channel output.
Claim 19	
19	The method of claim 13, wherein the method comprises: demodulating each digitally down converted, desired channel to generate a plurality of demodulated channels.
Claim 20	
20	The method of claim 19, wherein the method comprises: providing the plurality of demodulated channels via a parallel interface.
Claim 21	

Designation	Claim Language
21	The method of claim 13, wherein: the plurality of desired channels comprises at least one cable broadcast channel.
Claim 22	
22	The method of claim 13, wherein: the plurality of desired channels comprises at least one channel delivered via a Data Over Cable Service Interface Specification (DOCSIS) protocol.
Claim 23	
23	The method of claim 13, wherein: the method is performed by a device comprising a digital video recorder (DVR).
Claim 24	
24	The method of claim 13, wherein the method comprises: providing a picture-in-picture display signal according to the plurality of digital channel outputs.
Claim 25	
[25A]	A method for receiving a television (TV) signal comprising:
[25B]	receiving an input signal from a cable network;
[25C]	digitizing a contiguous band of frequencies in the input signal via a wideband analog-to-digital converter (ADC), wherein the contiguous band of frequencies comprises all received channels that exist in the input signal and the received channels comprise a plurality of desired channels and a plurality of undesired channels;
[25D]	concurrently selecting each of the plurality of desired channels from the input signal without selecting any of the plurality of undesired channels; and
[25E]	providing the plurality of desired channels,
[25F]	wherein the method is performed by a device comprising a digital video recorder (DVR).
Claim 26	
26	The method of claim 25, wherein the method comprises: communicating the input signal from a cable network connector to the wideband ADC via at least one of an analog amplifier and an analog filter.
Claim 27	
[27A]	The method of claim 25, wherein the method comprises:

Designation	Claim Language
	generating, via each mixer of a plurality of mixers, a complex signal corresponding to each of the plurality of desired channels, and
[27B]	wherein each corresponding complex signal comprises an in-phase (I) component and a quadrature (Q) component.
Claim 28	
28	The method of claim 27, wherein: the I and Q components of each corresponding complex signal are at baseband.
Claim 29	
29	The method of claim 27, wherein the method comprises: filtering, via each filter of a plurality of filters, the corresponding complex signal, and wherein each corresponding complex signal comprises a 6 MHz channel.
Claim 30	
30	The method of claim 27, wherein the method comprises: demodulating, via each demodulator of a plurality of demodulators, the corresponding complex signal to generate a demodulated signal as a desired channel output.
Claim 31	
31	The method of claim 25, wherein the method comprises: demodulating, via each demodulator of a plurality of demodulators, a desired channel, of the plurality of desired channels.
Claim 32	
32	The method of claim 31, wherein the method comprises: providing a plurality of demodulated desired channels via a parallel interface.
Claim 33	
33	The method of claim 25, wherein the method comprises: providing the plurality of desired channels via a parallel interface.
Claim 34	
34	The method of claim 25, wherein the method comprises: providing the plurality of desired channels via a serial interface.
Claim 35	
35	The method of claim 25, wherein:

Designation	Claim Language
	the plurality of desired channels comprises at least one cable broadcast channel.
Claim 36	
36	The method of claim 25, wherein: the plurality of desired channels comprises at least one channel delivered via a Data Over Cable Service Interface Specification (DOCSIS) protocol.
Claim 37	
37	The method of claim 25, wherein the method comprises: configuring at least some of the plurality of desired channels as an output for a picture-in-picture display.
Claim 38	
[38A]	A method comprising:
[38B]	receiving an input signal from a cable network;
[38C]	digitizing all received channels in the input signal via a wideband analog-to-digital converter (ADC), wherein the received channels comprise a plurality of desired channels and a plurality of undesired channels; and
[38D]	digitally down converting each desired channel, of the plurality of desired channels, to generate a plurality of digital channel outputs,
[38E]	wherein the method is performed by a device comprising a digital video recorder (DVR).
Claim 39	
39	The method of claim 38, wherein the method comprises: communicating the input signal from a cable network connector to the wideband ADC via at least one of an analog amplifier and an analog filter.
Claim 40	
[40A]	The method of claim 38, wherein: digitally down converting comprises generating a corresponding complex signal for each of the plurality of desired channels, and
[40B]	wherein each corresponding complex signal comprises an in-phase (I) component and a quadrature (Q) component.
Claim 41	
41	The method of claim 40, wherein:

Designation	Claim Language
	the I and Q components of each corresponding complex signal are at baseband.
Claim 42	
42	The method of claim 40, wherein the method comprises: a filtering the corresponding complex signal, wherein a bandwidth of the complex signal is 6 MHz.
Claim 43	
43	The method of claim 40, wherein the method comprises: demodulating the corresponding complex signal to provide a demodulated channel as a digital channel output.
Claim 44	
44	The method of claim 38, wherein the method comprises: demodulating each digitally down converted, desired channel to generate a plurality of demodulated channels.
Claim 45	
45	The method of claim 44, wherein the method comprises: providing the plurality of demodulated channels via a parallel interface.
Claim 46	
46	The method of claim 38, wherein the method comprises: providing the plurality of digital channel outputs via a parallel interface.
Claim 47	
47	The method of claim 38, wherein the method comprises: providing the plurality of digital channel outputs via a serial interface.
Claim 48	
48	The method of claim 38, wherein: the plurality of desired channels comprises at least one cable broadcast channel.
Claim 49	
49	The method of claim 38, wherein: the plurality of desired channels comprises at least one channel delivered via a Data Over Cable Service Interface Specification (DOCSIS) protocol.
Claim 50	
50	The method of claim 38, wherein the method comprises:

Designation	Claim Language
	providing a picture-in-picture display signal according to the plurality of digital channel outputs.
Claim 51	
[51A]	A method for receiving a television (TV) signal comprising:
[51B]	receiving an input signal from a cable network;
[51C]	digitizing a contiguous band of frequencies in the input signal via a wideband analog-to-digital converter (ADC), wherein the contiguous band of frequencies comprises all received channels that exist in the input signal and the received channels comprise a plurality of desired channels and a plurality of undesired channels;
[51D]	concurrently selecting each of the plurality of desired channels from the input signal without selecting any of the plurality of undesired channels;
[51E]	providing the plurality of desired channels; and
[51F]	configuring at least some of the plurality of desired channels as an output for a picture-in-picture display.
Claim 52	
52	The method of claim 51, wherein the method comprises: communicating the input signal from a cable network connector to the wideband ADC via at least one of an analog amplifier and an analog filter.
Claim 53	
[53A]	The method of claim 51, wherein the method comprises: generating, via each mixer of a plurality of mixers, a complex signal corresponding to each of the plurality of desired channels, and
[53B]	wherein each corresponding complex signal comprises an in-phase (I) component and a quadrature (Q) component.
Claim 54	
54	The method of claim 53, wherein: the I and Q components of each corresponding complex signal are at baseband.
Claim 55	
55	The method of claim 53, wherein the method comprises: filtering, via each filter of a plurality of filters, the corresponding complex signal, and wherein each corresponding complex signal comprises a 6 MHz channel.

Designation	Claim Language
Claim 56	
56	The method of claim 53, wherein the method comprises: demodulating, via each demodulator of a plurality of demodulators, the corresponding complex signal to generate a demodulated signal as a desired channel output.
Claim 57	
57	The method of claim 51, wherein the method comprises: demodulating, via each demodulator of a plurality of demodulators, a desired channel, of the plurality of desired channels.
Claim 58	
58	The method of claim 57, wherein the method comprises: providing a plurality of demodulated desired channels via a parallel interface.
Claim 59	
59	The method of claim 51, wherein the method comprises: providing the plurality of desired channels via a parallel interface.
Claim 60	
60	The method of claim 51, wherein the method comprises: providing the plurality of desired channels via a serial interface.
Claim 61	
61	The method of claim 51, wherein: the plurality of desired channels comprises at least one cable broadcast channel.
Claim 62	
62	The method of claim 51, wherein: the plurality of desired channels comprises at least one channel delivered via a Data Over Cable Service Interface Specification (DOCSIS) protocol.
Claim 63	
63	The method of claim 51, wherein: the method is performed by a device comprising a digital video recorder (DVR).
Claim 64	
[64A]	A method comprising:
[64B]	receiving an input signal from a cable network;

Designation	Claim Language
[64C]	digitizing all received channels in the input signal via a wideband analog-to-digital converter (ADC), wherein the received channels comprise a plurality of desired channels and a plurality of undesired channels;
[64D]	digitally down converting each desired channel, of the plurality of desired channels, to generate a plurality of digital channel outputs; and
[64E]	configuring at least some of the plurality of desired channels as an output for a picture-in-picture display.
Claim 65	
65	The method of claim 64, wherein the method comprises: communicating the input signal from a cable network connector to the wideband ADC via at least one of an analog amplifier and an analog filter.
Claim 66	
[66A]	The method of claim 64, wherein: digitally down converting comprises generating a corresponding complex signal for each of the plurality of desired channels, and
[66B]	wherein each corresponding complex signal comprises an in-phase (I) component and a quadrature (Q) component.
Claim 67	
67	The method of claim 66, wherein: the I and Q components of each corresponding complex signal are at baseband.
Claim 68	
68	The method of claim 66, wherein the method comprises: a filtering the corresponding complex signal, wherein a bandwidth of the complex signal is 6 MHz.
Claim 69	
69	The method of claim 66, wherein the method comprises: demodulating the corresponding complex signal to provide a demodulated channel as a digital channel output.
Claim 70	
70	The method of claim 64, wherein the method comprises: demodulating each digitally down converted, desired channel to generate a plurality of demodulated channels.
Claim 71	

Designation	Claim Language
71	The method of claim 70, wherein the method comprises: providing the plurality of demodulated channels via a parallel interface.
Claim 72	
72	The method of claim 64, wherein the method comprises: providing the plurality of digital channel outputs via a parallel interface.
Claim 73	
73	The method of claim 64, wherein the method comprises: providing the plurality of digital channel outputs via a serial interface.
Claim 74	
74	The method of claim 64, wherein: the plurality of desired channels comprises at least one cable broadcast channel.
Claim 75	
75	The method of claim 64, wherein: the plurality of desired channels comprises at least one channel delivered via a Data Over Cable Service Interface Specification (DOCSIS) protocol.
Claim 76	
76	The method of claim 64, wherein: the method is performed by a device comprising a digital video recorder (DVR).