

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

COMCAST CABLE COMMUNICATIONS, LLC,
Petitioner

v.

ENTROPIC COMMUNICATIONS, LLC.,
Patent Owner.

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

Inter Partes Review No.: IPR2024-00437

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.***

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

1. INTRODUCTION

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

2. I have been asked to provide a declaration regarding certain matters pertaining to U.S. Patent No. 11,381,866 (“the ’866 patent”) (Ex. 1201) and the unpatentability grounds set forth in the Petition for this proceeding. My experience with television distribution systems, Set Top Boxes (STBs), modulation schemes, radio frequency systems, Video on Demand (VOD), and content delivery systems provides me with an understanding of the subject matter described and claimed in the ’866 patent.

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

2. PROFESSIONAL BACKGROUND AND QUALIFICATIONS

4. I am a technical consultant and product development industry veteran with expertise in electronics, software, hardware, video, audio, and data communications, having led product development organizations in cable, satellite, consumer electronics, home automation, asset tracking, remote tank logistics, and alarm industries. My current curriculum vitae is attached as Ex. 1203 and some highlights follow.

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

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

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

8. From 1985 to 1990, I worked at Wegener Communications as a Senior Electrical Engineer, designing satellite communications equipment, including forward error correction (FEC) coding systems, PSK modems, and analog control systems for RF modulators and PSK demodulators. I was promoted to the Hardware Engineering Manager, where I managed product development of video, audio, and data satellite receivers, modulators, graphics display systems, DSP-based companders, FSK and PSK satellite modems, multiplexers, forward error correction (FEC) codecs, RF upconverters and downconverters, and baseband analog and digital processing components.

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

MPEG-2, H.264, NTSC, PAL, DAVIC, MoCA, high-performance CPUs, cablecards, network processors, HDMI, multiple video/audio display interfaces, 2D/3D graphics, multiple RF tuners, and full spectrum tuners.

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

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

12. From 2019 to 2022, I worked as Chief Technology Officer for Telular, an Ametek company. I was responsible for the development of Industrial Internet of Things (IIoT) recurring revenue solutions, combining wireless technologies,

purpose-built hardware, and SaaS in the commercial telematics, security and home automation markets and sold under the SkyBitz and Telguard brands.

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

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

- U.S. Patent No. 9,882,736 titled “Remote Sound Generation for a Home Automation System”
- U.S. Patent No. 9,615,139 titled “Determining Device That Performs Processing of Output Pictures”
- U.S. Patent No. 8,549,567 titled “Media Content Sharing Over a Home Network”
- U.S. Patent No. 8,161,388 titled “Interactive discovery of display device characteristics”

- U.S. Patent Nos. 8,120,924, 7,240,217, 6,785,817, 6,564,324, 6,212,278, and 5,440,632 titled “Reprogrammable Subscriber Terminal”
- U.S. Patent No. 7,908,625 titled “Networked Multimedia System”
- U.S. Patent Nos. 7,861,272 and 7,849,486 titled “Networked Subscriber Television Distribution”
- U.S. Patent Nos. 7,774,820 and 7,069,578 titled “Settop Cable Television Control Device and Method Including Bootloader Software and Code Version Table for Maintaining and Updating Settop Receiver Operating System Software”
- U.S. Patent No. 5,771,064 titled “Home Communications Terminal having an Applications Module”
- U.S. Patent No. 5,715,515 titled “Method and Apparatus for Downloading On-Screen Graphics and Captions to a Television Terminal”
- U.S. Patent No. 5,657,414 titled “Auxiliary Device Control for a Subscriber Terminal”

- U.S. Patent No. 5,592,551 titled “Method and Apparatus for Providing Interactive Electronic Programming Guide”
- U.S. Patent No. 5,539,822 titled “System and Method for Subscriber Interactivity in a Television System”
- U.S. Patent No. 5,357,276 titled “Method of Providing Video On Demand with VCR Like Functions”
- U.S. Patent Application Publication Nos. 2004/0068753 and 2008/0072272 titled “Video Transmission Systems and Methods for a Home Network”
- U.S. Patent Application Publication No. 2004/0133911 titled “Subscriber Network in a Satellite System”

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

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

invention of the '866 patent, which I (as I discuss below) understand is early 2009 or early 2010.

3. MATERIALS CONSIDERED

17. In formulating my opinion, I reviewed and considered the '866 patent (U.S. Pat. No. 11,381,866 to Reddy et al.) (Ex. 1201), as to which I am offering my opinion regarding the validity of certain claims, as discussed herein.

18. In preparing this declaration, I also reviewed and considered the Petition and the file history of the '866 patent (included in Ex. 1204) as well as the following references:

Ex. 1201:	U.S. Patent No. 11,381,866 (“the '866 patent”)
Ex. 1202:	Expert Declaration of David B. Lett
Ex. 1203:	Curriculum Vitae of David B. Lett
Ex. 1204:	Certified Prosecution History of the '866 patent
Ex. 1205:	Certified Prosecution History of U.S. Patent No. 9,100,622
Ex. 1206:	Certified Prosecution History of U.S. Patent No. 8,526,898
Ex. 1207:	Certified Prosecution History of U.S. Provisional App. No. 61/170,526 (“’526 provisional”)
Ex. 1214:	U.S. Patent No. 7,237,214 (“Pandey”)
Ex. 1215:	Excerpts of “IEEE Std 100-2000, The Authoritative Dictionary of IEEE Standards Terms, Seventh Edition” (IEEE Press. 2000) (“IEEE Std 100”)
Ex. 1216:	Excerpts of Jan M Rabaey, “Digital Integrated Circuits: A Design Perspective” (Pearson, 2nd ed. 2002) (“Rabaey”)

- Ex. 1217: 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. 1218: S. Mirabbasi and K. Martin, “Classical and Modern Receiver Architectures,” IEEE Communications Magazine, vol. 38, no. 11, pp. 132-139, November 2000 (“Mirabbasi”)
- Ex. 1219: U.S. Patent No. 6,061,406 (“Carson”)
- Ex. 1221: “Data-Over-Cable Service Interface Specifications: Radio Frequency Interface Specification CM-SP-RFiv2.0-I11-060602,” DOCSIS, June 2006
- Ex. 1224: International Pub. No. 2007/145367 (“Pugel”)
- Ex. 1225: 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. 1227: U.S. Patents and Patent Applications Family Tree for U.S. Patent No. 11,381,866
- Ex. 1230: U.S. Pub. No. 2006/0029170 (“Jensen ’170”)
- Ex. 1233: 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. 1234: Excerpts of J. Crols and M. Steyaert, “CMOS Wireless Transceiver Design” (1997)
- Ex. 1235: U.S. Patent No. 7,340,230 (“Khoini-Poorfard”)
- Ex. 1236: U.S. Pub. No. 2003/0217362 (“Summers”)
- Ex. 1237: U.S. Pub. No. 2006/0256799 (“Eng”)
- Ex. 1238: U.S. Pub. No. 2006/0083335 (“Seendripu”)

- Ex. 1239: Excerpts of Chris Bowick, “RF Circuit Design” (2nd ed. 2008)
- Ex. 1241: Excerpts of Roland Priemer, “Introductory Signal Processing” (1991)
- Ex. 1242: U.S. Patent No. 7,272,375 (“Tuttle”)
- Ex. 1243: U.S. Patent No. 7,130,576 (“Gurantz”)
- Ex. 1244: U.S. Patent No. 5,278,837 (“Kelly”)
- Ex. 1245: Jeffrey Hugh Reed, “Software Radio: A Modern Approach to Radio Engineering” (2002)
- Ex. 1246: U.S. Patent No. 7,213,042 (“Cannon”)
- Ex. 1248: Excerpts of William Buchanan, “Computer Busses” (2000) (“Buchanan”)
- Ex. 1249: U.S. Patent No. 7,079,528 (“Ziegler”)
- Ex. 1250: Excerpts of “Software Defined Radio: Enabling Technologies” (Walter H.W. Tuttlebee ed., 2003)
- Ex. 1251: U.S. Pub. No. 2005/0183015 (“Dunton”)
- Ex. 1252: U.S. Pub. No. 2003/0229900 (“Reisman”)
- Ex. 1273: Expert Declaration of Dr. Sylvia Hall-Ellis
- Ex. 1274: U.S. Pub. No. 2008/0120667 (“Zaltsman”)
- Ex. 1275: U.S. Patent No. 6,791,995 (“Azenkot”)
- Ex. 1276: U.S. Patent No. 6,542,203 (“Shadwell”)

4. UNDERSTANDING OF APPLICABLE LEGAL STANDARDS

19. Although I am not an attorney, I have a general understanding of the applicable legal standards pertaining to the patentability issues presented in this

proceeding. I understand that the Petitioner is challenging the patentability of the claims of the '866 patent based on the following grounds:

20.

Ground	References	Basis	Claims Challenged
A0	Pugel	§102	27 , 28, 33, 37, 39, 40, 41 , 42, 47, 51, 53, 54, 55 , 56, 61, 65, 67, 68, 69 , 70, 75, 79, 81, 82
A1	Pugel	§103	27 , 28, 33, 37, 39, 40, 41 , 42, 47, 51, 53, 54, 55 , 56, 61, 65, 67, 68, 69 , 70, 75, 79, 81, 82
B	Pugel, Crols	§103	27-30 , 32-33, 37, 39-40, 41 , 42- 44, 46-47, 51, 53-54, 55 , 56-58, 60-61, 65, 67-68, 69 , 70-72, 74- 75, 79, 81-82
C	Pugel, Zaltsman	§103	38, 52, 66, 80
D	Pugel, Crols, Zaltsman, Jensen '170	§103	31, 45, 59, 73

E	Pugel, Chandrakasan	§103	1, 2, 7, 8, 9, 11, 12, 13, 14, 15, 20, 21, 22, 24, 25, 26, 34, 35 36, 48, 49, 50, 62, 63, 64, 76, 77, 78
F	Pugel, Chandrakasan, Crols	§103	3, 4, 6, 16, 17, 19
G	Pugel, Chandrakasan, Zaltsman	§103	10, 23
H	Pugel, Chandrakasan, Crols, Zaltsman, Jensen '170	§103	5, 18

21. 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.

22. 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.

23. 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.

24. 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.

25. 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.

26. 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.

27. 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.

28. 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.

29. 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.

30. 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

31. I understand that obviousness is determined from the vantage point of a person of ordinary skill in the relevant art at the time of the alleged invention (“POSITA”). The ’866 patent is directed to a wideband receiver system 200 “capable of receiving multiple desired television channels that extend over multiple non-contiguous portions of the broad frequency spectrum.” Ex. 1201, 1:29-34. I understand that a person of ordinary skill in the art is one who is presumed to be aware of all pertinent art, thinks along conventional wisdom in the art, and is a person of ordinary creativity.

32. I believe that a person of ordinary skill in the art of the ’866 patent, at the time of the alleged invention of the ’866 patent, would have had a degree in electrical engineering, or a similar discipline, along with three-to-four years of

experience with digital signal processing (DSP) and RF tuning systems for satellite and/or cable communications. I also believe that additional education may substitute for professional experience, and significant work experience may substitute for formal education. I worked in the relevant field with such persons at, and leading up to, the time of the alleged invention of the '866 patent, and thus, I am familiar with the knowledge that such persons had at the time (*i.e.*, early 2009 or early 2010).

33. 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, before the earliest claimed priority date of the '866 patent (which, as I discuss below, is April 17, 2009). Although some claims of the '866 patent are entitled to different priority dates, the level of ordinary skill in the art would not have changed significantly between April 17, 2009, and April 19, 2010.

6. CLAIM CONSTRUCTION

34. I understand that my analysis requires an understanding of the scope of the claims of the '866 patent. I understand that claim terms subject to inter partes review, absent some other definition provided in the patent, are given their ordinary meaning to a person of ordinary skill in the art in light of the patent specification. Therefore, in my analyses given below, I have assumed that all claim terms are given their ordinary interpretation as would have been understood by a POSITA reading

the patent specification as of the priority date. I further understand that certain claim terms may be means plus function limitations. In particular, I understand that a “means plus function” limitation should be interpreted to cover only the corresponding structure described in the specification that performs the recited function, and equivalents thereof. I also understand that a limitation will be presumed to be a means plus function limitation if (a) the claim limitation uses the phrase “means for”; (b) the “means for” is modified by functional language; and (c) the phrase “means for” is not modified by sufficient structure for achieving the specified function. I understand that a structure will be considered structurally equivalent to the corresponding structure identified in the specification only if the differences between them are insubstantial. For example, a structure may be deemed to be a structural equivalent to the corresponding structure where the structure performs the same function in substantially the same way to achieve substantially the same result.

35. 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.

6.1. “Wideband”

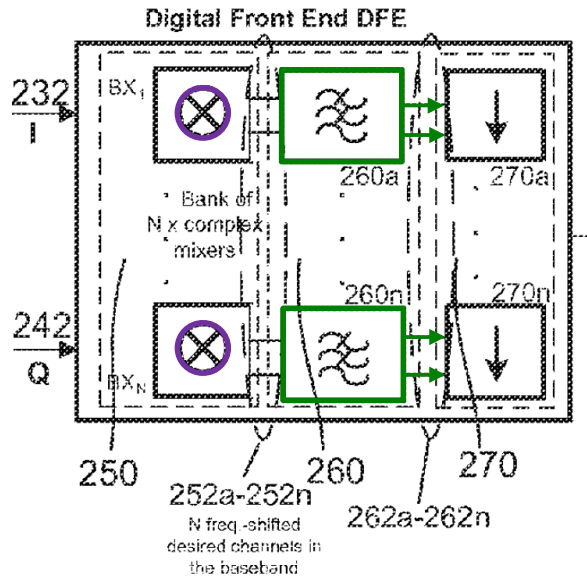
36. The claims use the term “wideband.” The ’866 patent implicitly defines “wideband” as a band that carries multiple channels. For example, the ’866 patent states that a receiver is “wideband” if it is “designed to concurrently receive several TV channels.” Ex. 1201, 1:36-39. In my opinion, this is consistent with the ordinary and customary meaning of “wideband.”

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

37. Independent claims 14, 41, and 69 recite a “plurality of digital down converters” that are “operable to generate a digital channel output corresponding to each desired channel.” A POSITA would have understood that the plain and ordinary meaning of digital down converter, as the term states, is digital circuitry that downconverts a digital signal. The ’866 patent specification and figures omit the term “digital down converter” (or “down converter”), but describe a “Digital Front End (DFE)” that downconverts digital signals with components operable to perform the functions and comprises the elements attributed to “digital down converters” in the claims. Ex. 1201, Figs. 2-3, 5:51-7:9, 9:50-60. Independent claims 1, 27 and 25 use the term DFE that, similar to the digital downconverters of claims 14, 41, and 69, is “configured to concurrently select and provide each of the plurality of desired channels,” but also requires “without providing any of the plurality of undesired channels.”

38. The example DFE from Figure 2 (below) includes a plurality of signal paths, with each path including a complex mixer 250 (**purple**), a low pass filter 260 (**green**), and optionally a demodulator with a serial or parallel interface to the demodulator.¹ Ex. 1201, Figs. 2-3, 5:51-7:9, 9:50-60. Each of these signal paths performs the function that claims 14, 41, and 69 ascribe to a digital down converter—generating a digital channel output corresponding to a desired channel. Ex. 1201, 5:51-7:9, 9:50-60, Figs. 2-3. That this structure is the digital down converter in the '866 patent is consistent with the dependent claims, which require the digital down converter(s) to have a digital mixer, filter, demodulator, and a serial or parallel interface. Ex. 1201, claims 16, 18-21, 40, 43-50, 68, and 71-76. The complex mixer in each path further performs “down-converting,” which the '866 patent describes as shifting of the frequency of a signal to a lower frequency (also termed “down shift” and “frequency shift). Ex. 1201, 1:38-40, 2:2-6, 2:13-28, 2:59-63, 2:65-3:2, 4:60-66, 6:3-6, 6:7-56, 7:47-55, 9:18-26.

¹ The '866 patent alternatively refers to the boxes following the filters in Figures 2 and 3 as decimators and/or demodulators, and also discloses the DFE as having outputs to a demodulator. Ex. 1301, Figs. 2-3, 6:8-14, 7:4-9, 9:50-60.



Ex 1101, Fig. 2 (annotated and excerpted)

39. I do not believe that “digital down converter” and “digital front end” are means-plus-function terms. To the extent that either term is so construed to be a means-plus-function term, the corresponding structure for “digital down converter” includes the components in one signal path in the DFE, i.e., a complex mixer 250 and a filter 260, and the corresponding structure for a “digital front end” include two such signal paths. Ex. 1201, Figs. 2-3, 5:51-7:9, 9:50-60.

7. OVERVIEW OF THE '866 PATENT

40. The '866 Patent describes a wideband receiver system 200 illustrated below “capable of receiving multiple radio frequency channels located in a broad radio frequency spectrum.” Ex. 1201, 1:26-29, 4:35-37. According to the '866

Patent, a receiver is “wideband” if it is “designed to concurrently receive several TV channels.” Id., 1:35-38.

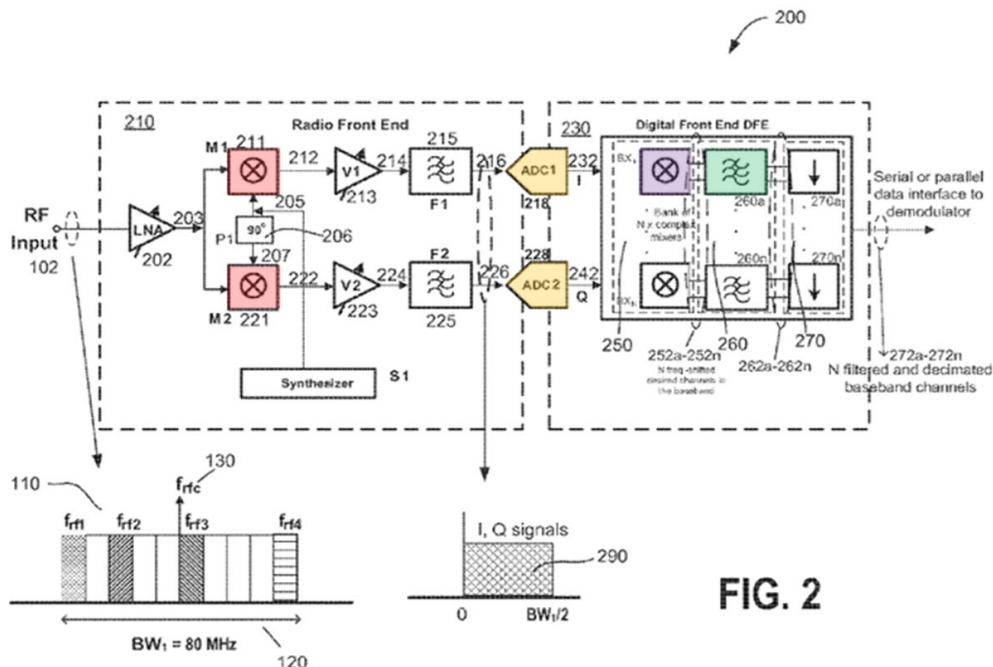


FIG. 2

Ex. 1201, Fig. 2 (annotated)

41. The system 200 receives desired and undesired television channels as frequencies dispersed within a frequency bandwidth BW_1 . Ex. 1201, 4:38-50. A radio frontend 210 (red) downconverts the bandwidth of channels as in-phase and quadrature signals 212 and 222 at a low intermediate frequency (IF), which are then digitized by wideband analog-to-digital converters ADC1 and ADC2 (gold). Ex. 1201, 2:59-65, 4:61-5:7, 5:20-24, 5:48-51. U.S. Provisional App. No. 61/170,526 (“526 provisional”), which the ’866 patent incorporates by reference, admits that the left side of Figure 2 (up to and including ADC1 and ADC2) “is similar to conventional tuners.” Ex. 1207 at 4; Ex. 1201, 1:6-22.

42. The digital I and Q signals 232 and 242 from ADC1 and ADC2 are input to a bank of N complex mixers 250 (one annotated above in **purple**) in a digital front end 230. Ex. 1201, 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. 1201, 6:2-6. Filters 260a-260n (one annotated above in **green**) filter each frequency-shifted desired channel. Ex. 1201, 6:6-8. After (optional) decimation, baseband channels from multiple rows of digital front end 230 “will be sent as a serial or parallel digital data stream to a demodulator using a serial or parallel data interface according to commonly known methods.” Ex. 1201, 7:10-14.

7.1. Prosecution History

43. It is my understanding that U.S. Application No. 17/587,415, which became the '866 patent, was filed on January 28, 2022, with a preliminary amendment canceling claims 1-18 and adding new claims 19-48 claims. Ex. 1204 at 2-109. On April 18, 2022, an Office Action rejected claims 19-48 for non-statutory double patenting over claims 1-27 of U.S. Patent No. 9,100,622, and rejected claims 19-27, 29-30, 33-42, 44-45, and 48 as obvious over U.S. Patent No. 6,760,342 (Skones et al.) in view of International Publication No. WO 02/087230 (Uskali et al.). Ex. 1204 at 119-132. 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. Ex. 1204 at 131.

44. On April 18, 2022, 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. Ex. 1204 at 148-175.

45. The Office issued a Notice of Allowance on May 25, 2022. Ex. 1204 at 188. The ’866 patent was issued on July 5, 2022. Ex. 1201, cover.

46. The prior art relied upon in this petition— Pugel, Crols, Chandrakasan, or Jensen ’170 —was not considered during the prosecution of the ’866 patent or during the prosecution of any of the parent priority applications.

7.2. Earliest Priority Date for the Claims

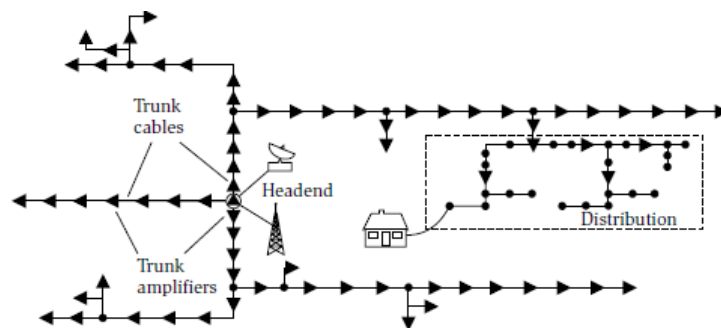
47. I understand that the earliest possible priority date for claims 1-9, 13-22, and 26 of the ’866 patent is April 17, 2009, the filing date of the ’526 provisional. Each of the references relied on herein is prior art to that date. The earliest possible

priority date for the remaining claims is April 19, 2010, the filing date of Application No. 12/762,900, as the '526 provisional is silent regarding a “channel delivered via ... DOCSIS[] protocol,” “DVR,” or “picture-in-picture display.” Ex. 1207, *passim*.

8. OVERVIEW OF THE PRIOR ART

8.1. Cable and Satellite Television Networks

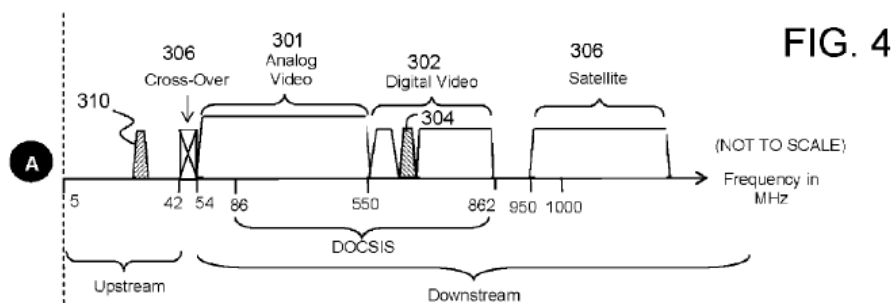
48. The origins of the cable and satellite television networks long predate the earliest claimed priority date (April 17, 2009) of the '866 patent. Cable television networks are entertainment distribution systems that allow consumers to access and enjoy various television channels. Ex. 1233 at 22. The 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. 1234 at 20-21. This is illustrated in Figure 1.1 of Ex. 1233.



Ex. 1233, Fig. 1.1 (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. 1215 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. 1221 at 2-5, Fig. 1-2; Ex. 1233 at 27, 211-212.

49. Consumers can also access television channels from satellites via conventional home satellite television systems. Ex. 1235, 1:30-31; Ex. 1236, [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. 1235, 1:31-35; Ex. 1236, [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. 1233 at 262, 280-282; Ex. 1236, [0009].



Ex. 1237, Fig. 4 (Excerpted)

50. Figure 4 of Exhibit 1237 (partially reproduced above) illustrates the RF spectrum usage of television channels from cable and satellite television networks. Ex. 1237, [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. 1233 at 413, 503; Ex. 1237, [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. 1221 at 1, 23-24; Ex. 1233 at 45, 413, 515-520.

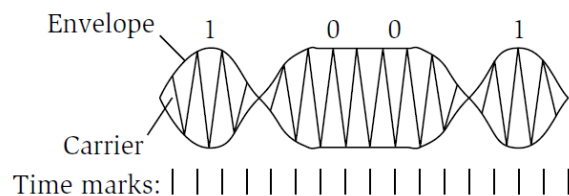
51. Television channels from satellite networks occupy various bands in frequencies greater than 950 MHz. Ex. 1235, 1:37-48; Ex. 1237, [0079]-[0080]. Signals in satellite bands are sent to a satellite receiver or set-top box, with the satellite bands carrying multiple transponder channels and each transponder channel carrying a number of different television channels. Ex. 1235, 1:37-48.

8.2. Modulated RF Signals

52. 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. 1233 at 155. The information to be transmitted can be digital data comprising of bits “1” and “0,” such as the digital data of television channels for transmission from headends

of cable television networks or subscriber locations. *Id.* One of the main goals of modulation is to squeeze as much data into the allocated RF bandwidth as possible, and that objective, known as spectral efficiency, measures how quickly data can be transmitted in an assigned RF bandwidth. *Id.* at 156. The unit of measurement of spectral efficiency is bits per second per Hz (b/s/Hz). *Id.* As I discuss below, by the earliest claimed priority date of the '866 patent, multiple modulation techniques facilitating high spectral efficiencies were known to a POSITA by the earliest claimed priority date of the '866 patent.

8.2.1. Biphase Shift Keying



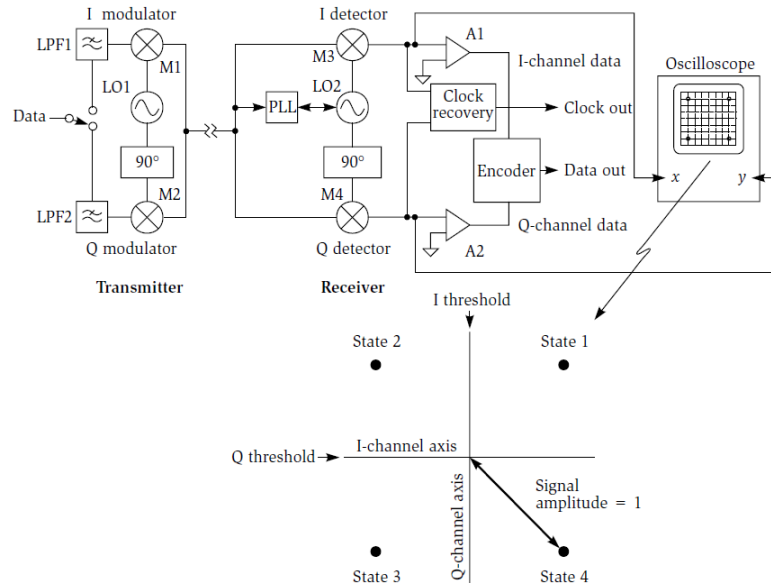
Ex. 1233, Fig. 4.3 (Excerpted) (page 161)

53. 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. 1233 at 160-161, Fig. 4.3 (partially reproduced above). The spectral efficiency of BPSK modulation is 1 bit/s/Hz. *Id.* at 156.

8.2.2. Quadrature Phase Shift Keying (QPSK)

54. 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. 1233 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.



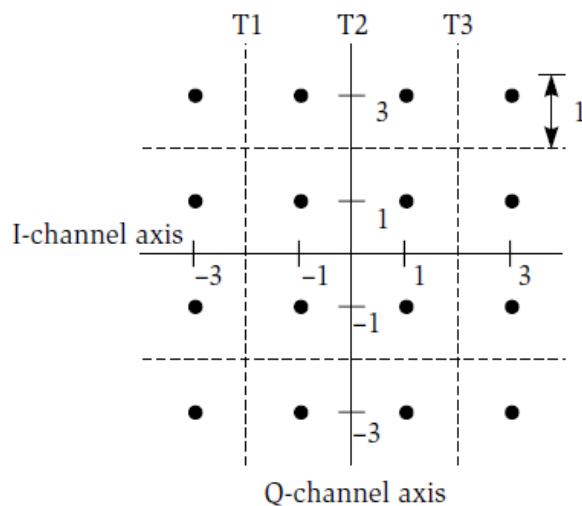
Ex. 1233, Fig. 4.4 (page 164)

55. 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. 1233 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.* 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.

56. A POSITA would have been well aware that satellite television networks primarily used QPSK modulation. Ex. 1233 at 280; Ex. 1236, [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. 1233 at 280. QPSK modulation met this requirement of satellite transponders. *Id.*

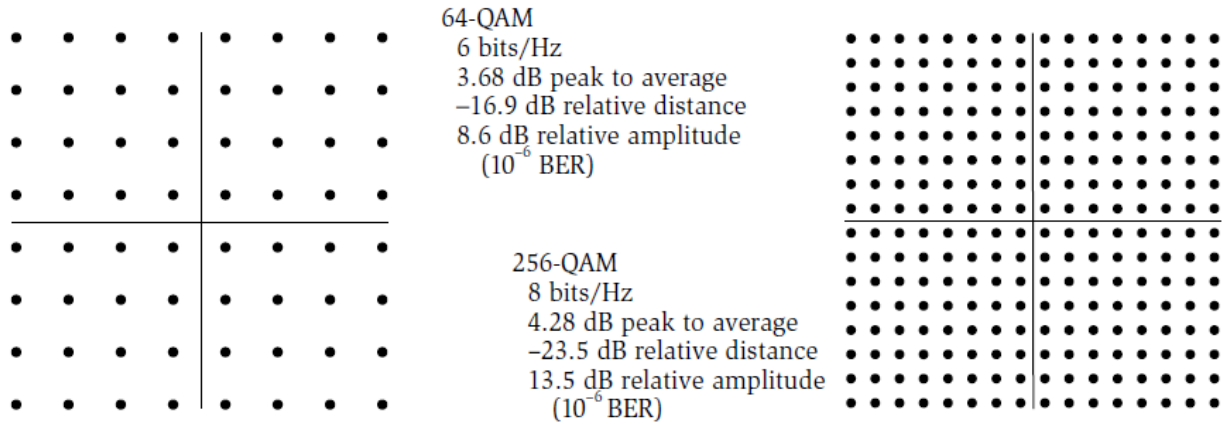
8.2.3. 16-Quadrature Amplitude Modulation (QAM), 64-QAM, and 256-QAM



Ex. 1233, Fig. 4.5 (Partial Excerpt) (page 167)

57. Modulation schemes with greater numbers of constellation points are able to transmit more information per symbol. Ex. 1233 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. 1233, 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.* The spectral efficiency of 16-QAM is 4 bit/s/Hz. *Id.* at 168, Fig. 4.6.



Ex. 1233, Fig. 4.6 (Partial Excerpt) (page 168)

58. Similarly, the I/Q constellation of 64-QAM (illustrated by Figure 4.6 of Ex. 1233, 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.*

59. 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. 1233 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

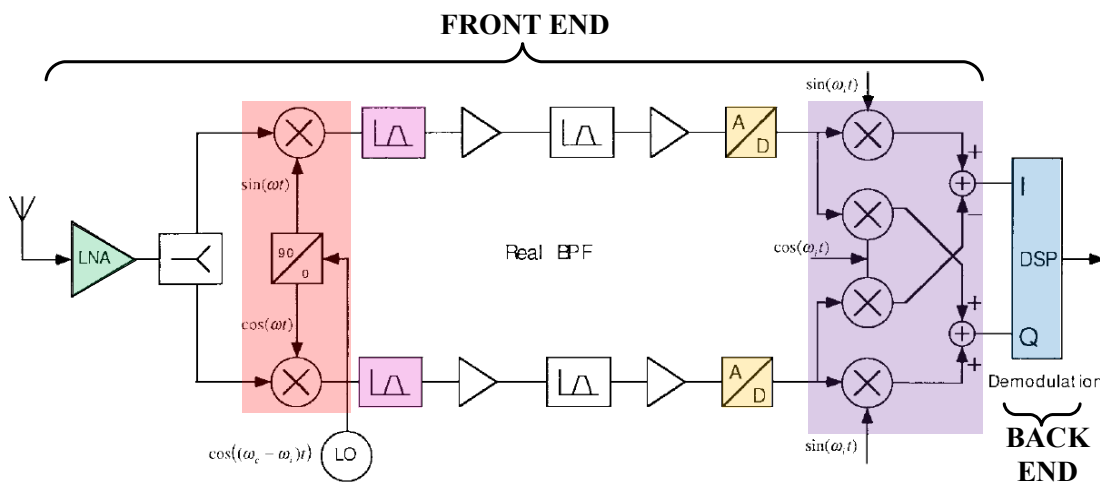
60. As discussed in Section 8.1, it was well-known to a POSITA that consumer terminal equipment (e.g., television receivers, cable set-top boxes, satellite set-top boxes, digital video recorders, personal video recorders, and other terminal equipment) receive modulated RF signals from headends and satellites. Ex. 1233 at 22, 30, 40, 352; Ex. 1235, 1:30-35; Ex. 1236, [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. 1233 at 408-411, Fig. 22.1; Ex. 1235, 1:35-37, 1:49-52; Ex. 1236, [0018], [0020]-[0021].

61. 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. 1233 at 413, 503; Ex. 1237, [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. 1235, 1:37-47; Ex. 1237, [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. 1233 at 299; Ex. 1236, [0020]-[0021]; Ex. 1242, 4:10-36; Ex. 1244, 1:51-58.

62. One type of receiver is known as an IF (intermediate frequency) receiver, and in particular, a type of receiver known as a low-IF receiver. By the earliest claimed priority date of the '866 patent, IF receivers, including low-IF receivers, were well-known in wireless communication systems for their high performance and low power consumption. Ex. 1225 at 270, 272; Ex. 1234 at 17, 65-74. It was also known to a POSITA, by the earliest claimed priority date of the '866 patent, that low-IF receivers were conventionally used for receiving RF signals from cable television networks and satellite television networks. Ex. 1235, 1:49-61; Ex. 1238, [0022]-[0023], [0029]-[0030], [0042].

63. IF receivers have been used for a long time, and their way of operating is very well known. Ex. 1225 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. 1215 at 4. Intermediate frequency falls below the frequency of the RF signals but above the baseband frequency. Ex. 1234 at 22. Low-IF receivers initially downconvert to an IF that is at a relatively low frequency, such as a few hundred kilohertz. Ex. 1225 at 269.

8.3.1. Architecture of Low-IF receivers



Ex. 1225, Fig. 22(a) (Annotated)

64. Low-IF receivers (illustrated by Figure 22(a) of Ex. 1225, 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. 1234 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. 1239 at 11; Ex. 1225 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. 1234 at 23.

65. Still referring to Figure 22(a) of Ex. 1225 (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

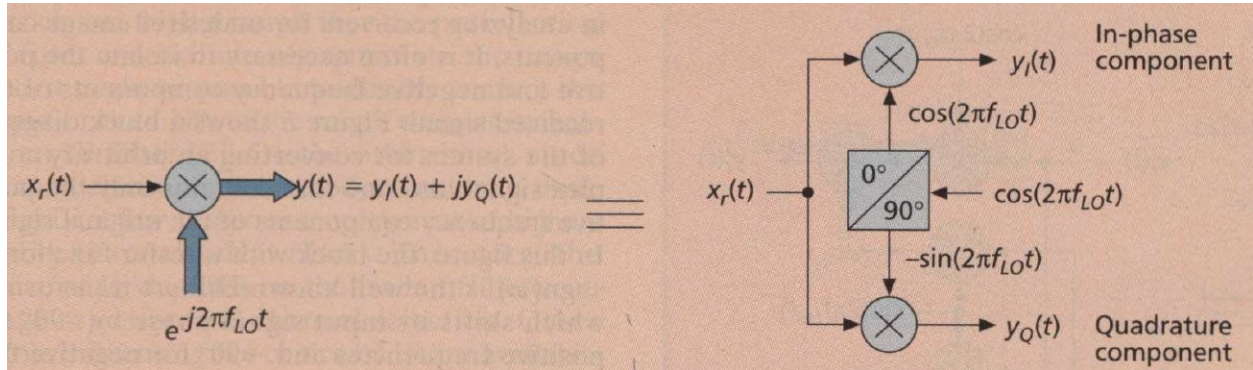
another device. Ex. 1234 at 41; Ex. 1239 at 16. The RF signals are downconverted to baseband signals in two steps, where the first step (**red**) converts the RF signals to Intermediate Frequency (IF) signals before one or more analog-to-digital converters (ADCs) (**gold**) convert IF signals to digital signals, and the second step (**purple**) converts the digital signals of IF to baseband signals. Ex. 1225 at 270, 272; Ex. 1234 at 23.

66. 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. 1234 at 65-72; Ex. 1239 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. 1218 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,

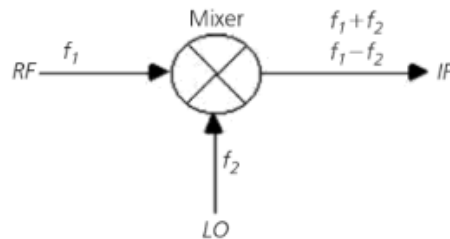
for comparison with case 2 in Fig. 1. In this case there is no image problem associated with the complex mixer.

Ex. 1218 at 134 (emphasis added).



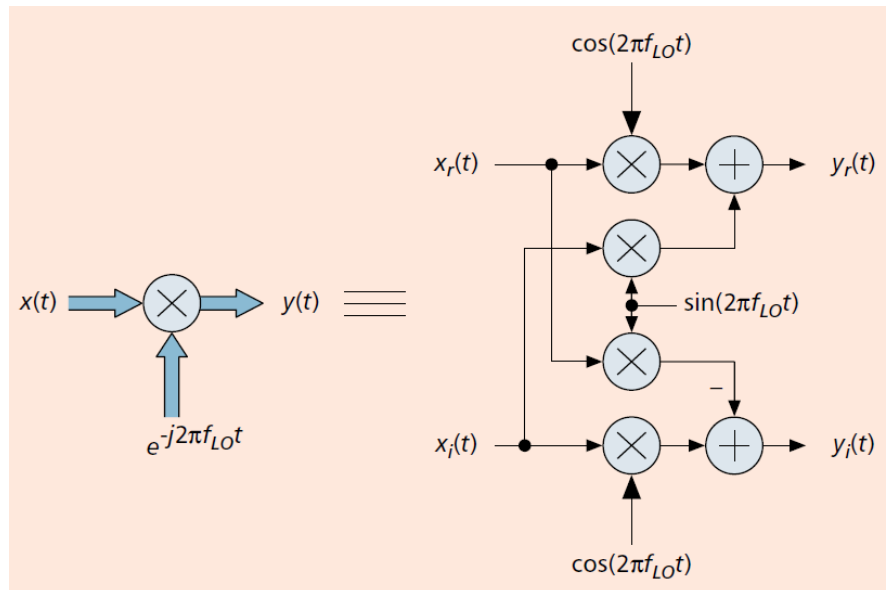
Ex. 1218, Fig. 2

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. 1239 at 12-13. This is illustrated in Figure 8-9 from Ex. 1239.



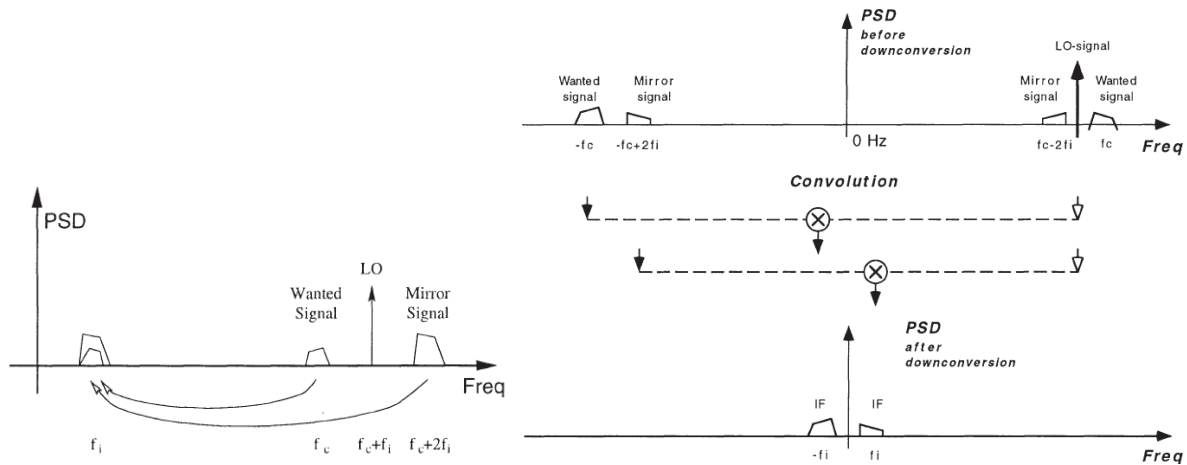
Ex. 1239, Fig. 8-9

By filtering out the signal with the sum (f_1+f_2), and passing only the signal with difference (f_1-f_2), the center frequency of the modulated input signal is reduced, or down-converted. A mixer/multiplier is “complex” if it multiplies the input signal by a complex signal, having real and imaginary parts, to produce in-phase and quadrature signals. Ex. 1218 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. 1225 above, or it can include four real mixers/multipliers if both the input signal and reference signal are complex as shown below. Ex. 1218 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. 1218, Fig. 3

67. Referring back to Figure 22(a) of Ex. 1225, the RF signals could also be downconverted using a single mixer and a sinusoidal signal (as shown by Figure 2.6 of Ex. 1234, 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. 1234 at 24.



Ex. 1234, Fig. 2.6 (page 26)

Ex. 1234, Fig. 3.23 (page 67)

68. 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. 1234 at 28, 43; Ex. 1239 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. 1234 at 23. Filters (pink) can be used after the first stage of downconversion to filter out unwanted mirror signals. *Id.* at 28; Ex. 1239 at 17.

69. 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. 1234 at 28; Ex. 1250 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. 1218 at 136; Ex. 1234 at 29; Ex. 1250 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 bondings between the different components of the RF receivers. Ex. 1218 at 136; Ex. 1234 at 29, 55-62; Ex. 1250 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. 1218 at 137-138; Ex. 1234 at 74. 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. 1218 at 138; Ex. 1234 at 29, 42, 55. However, such mismatches are not an issue in the second digital downconversion step. Ex. 1218 at 137; Ex. 1234 at 74, 76.

70. Analog-to-digital converters (ADCs) (**gold**) were commonly used in RF receivers for either IF or baseband signal sampling. Ex. 1239 at 18. Therefore, referring again to Figure 22(a) of Ex. 1225 (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. 1234 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

71. RF receivers receive RF signals for multiple television channels from cable and satellite television networks. Ex. 1235, 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. 1233 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. 1241 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. 1235, 11:13-23, Fig. 7A; Ex. 1242, 6:5-8, Fig. 1B; Ex. 1243, 5:13-29, 5:46-53; Ex. 1250 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. 1241 at 14.

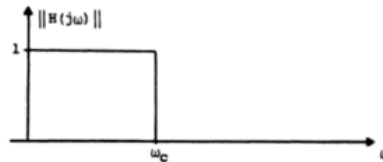


Fig. 1.23. Ideal LP filter magnitude frequency response.

Ex. 1241, Fig. 1.23

- Bandpass filter: A bandpass filter allows a specific range of frequencies (ω_1 to ω_2) to pass through while attenuating frequencies outside that range. Ex. 1241 at 21.

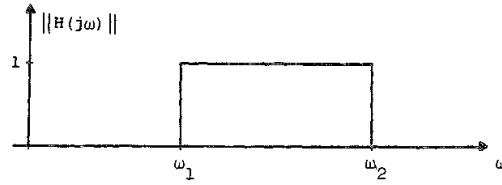


Fig. 1.27. Ideal BP filter.

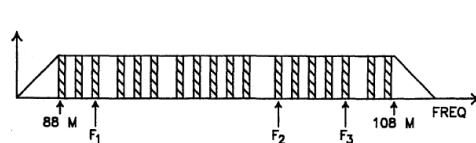
Ex. 1241, Fig. 1.27

A bandpass filter allows signals within a selected frequency range (e.g., signals for a selected television channel) to be isolated from undesired signals from outside the range. Ex. 1243, 5:13-15; Ex. 1250 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. 1243, 5:46-50; Ex. 1250 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. 1250 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. 1241 at 24-63; Ex. 1243, 5:15-17; Ex. 1250 at 44.

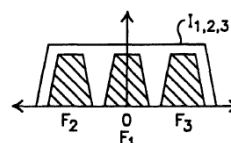
72. Some receivers may allow signals of two or more desired channels to be filtered out such that consumers may enjoy a feature called picture-in-picture, where a small window showing one of the desired television channels is inserted into a larger window showing another one of the desired television channels.

Ex. 1233 at 467; Ex. 1235, 4:37-43. For example, Khoini-Poorfard (Ex. 1235) 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. 1235, 4:37-43, 11:13-23, Fig. 7A.

8.3.3. Stacking of Desired Channels before Demodulation



Ex. 1244, Fig. 1



Ex. 1244, Fig. 6

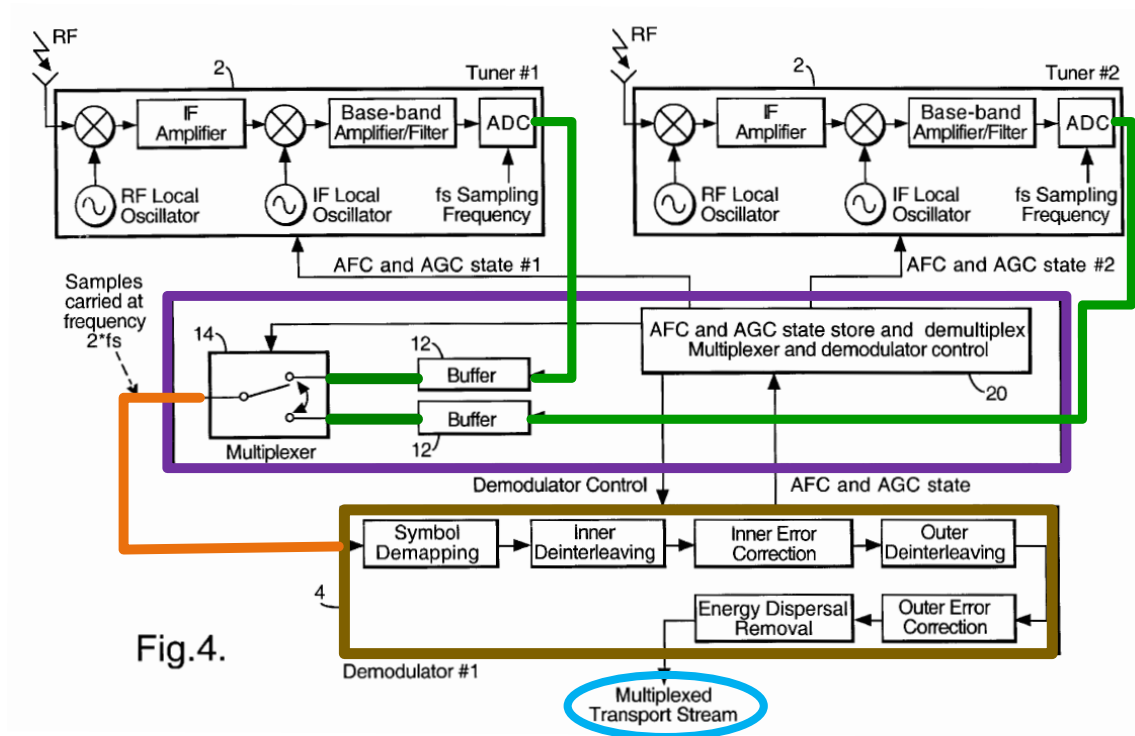
73. Khoini-Poorfard (Ex. 1235) describes using two RF receivers that individually filter and demodulate two television channels. Ex. 1235, 4:37-43, 11:13-23, Fig. 7A. Kelly (Ex. 1244) describes an RF receiver that demodulates multiple desired channel bands without expensive hardware requirements and hardware duplications. Ex. 1244, 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. 1244 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. 1244 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

74. 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. 1245 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. 1233 at 98. 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. 1233 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. 1234 at 104; Ex. 1245 at 70. Decimation is a well-known process that reduces the original sample rate of a signal to a lower rate. Ex. 1245 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. 1234 at 104; Ex. 1245, Fig. 3.57 (page 71); Ex. 1246, 2:51-57.

8.3.5. Demodulation of Multiple Channels

75. 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. 1219, 1:67-2:7, 2:32-35, 2:61-63, 3:50-52; Ex. 1244, 7:53-57. For example, Carson (Ex. 1219) describes a multichannel time-shared demodulator that demodulates the signals of multiple channels concurrently using time division multiple access (TDMA) techniques. Ex. 1219, 1:67-2:7, 2:32-35, 2:61-63, 3:50-52. Kelly (Ex. 1244) illustrates an RF receiver that demodulates two channels separately with two demodulators. Ex. 1244, 7:53-57. Another example is shown in Azenkot (Ex. 1275), 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. 1257, Abstract, 1:6-14, 6:14-22, 6:30-37; 7:15-20, 32:53-33:14. As another example, Shadwell (Ex. 1276) 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**).

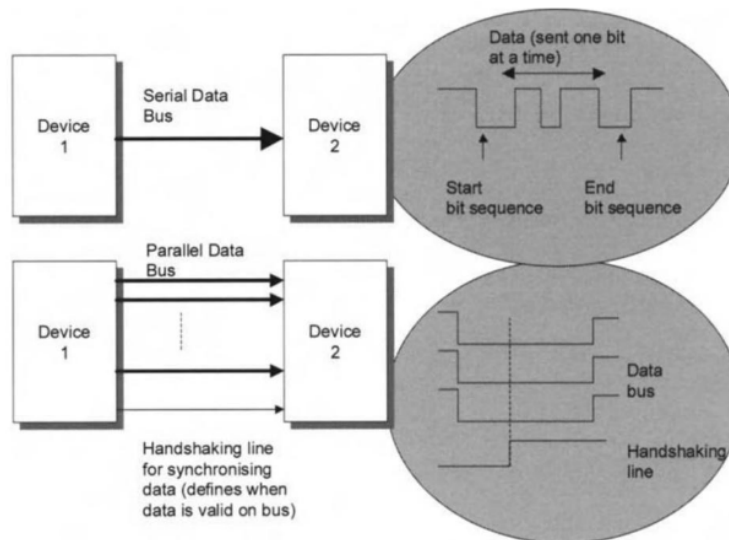


Ex. 1276, Fig. 4 (annotated).

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 Pugel as further discussed below, were capable of demodulating multiple selected channels. Ex. 1276, 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. 1276, 2:13-26, 2:53-59. Kelly (Ex. 1244) illustrates an RF receiver that demodulates two channels separately with two demodulators. Ex. 1244, 7:53-57.

8.4. Serial vs. Parallel Data Communication

76. As described throughout subsection 8.3 above, the different components of an IF receiver, including a low-IF receiver, were known to a POSITA prior to the '866 patent. It was also known to the POSITA by the earliest claimed priority date (April 17, 2009) of the '866 patent that the different components of low-IF receivers, such as the front end and the back end, could be fabricated on the same chipset or as different chipsets, and different types of buses could later connect the chipsets. Ex. 1234 at 23, 183; Ex. 1248 at 16. Data buses were known to pass data between electronic components. Ex. 1248 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. 1249, 1:10-28.



Ex. 1248, Fig. 2.3 (page 17)

77. 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. 1248 at 16. However, the parallel bus structure requires a larger number of conductors and more space on the chip. Ex. 1249, 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.*

78. Therefore, it was well known before the claimed priority date of the ’866 patent to use technologies such as those described above in subsections 8.2.2-8.2.3 to broadcast data for television channels using QPSK and QAM modulated RF signals, and to use radio frequency receivers and tuners, such as low-IF receivers, to receive and process the RF signals to select one or more desired television channels. As also discussed above, such processing was well-known to include channel stacking, downconversion, channel selection (e.g., filtering), demodulation, and decimation, as well as parallel and serial bussing between receiver components.

8.5. International Pub. No. 2007/145,637 – Pugel (Ex. 1224)

79. International Pub. No. 2007/145,637 (“Pugel”) (Ex. 1224) is a PCT Application Published December 21, 2007. As the publication date is more than a year prior to the earliest filing date of the ’866 patent, I understand that Pugel is prior

art under pre-AIA 35 U.S.C. § 102(b). I also understand that Pugel was not considered during the prosecution of the '866 patent. Ex. 1201, at 1-2.

80. Pugel describes a “digital television receiver capable of simultaneously receiving a plurality of channels ... suitable for use with conventional cable television delivery systems.” Ex. 1224, [0008]. Pugel’s Figure 1 shows a multichannel receiver circuit 100 annotated with colors referenced in the discussion below. Ex. 1224, [0022]-[0028], Fig. 1.

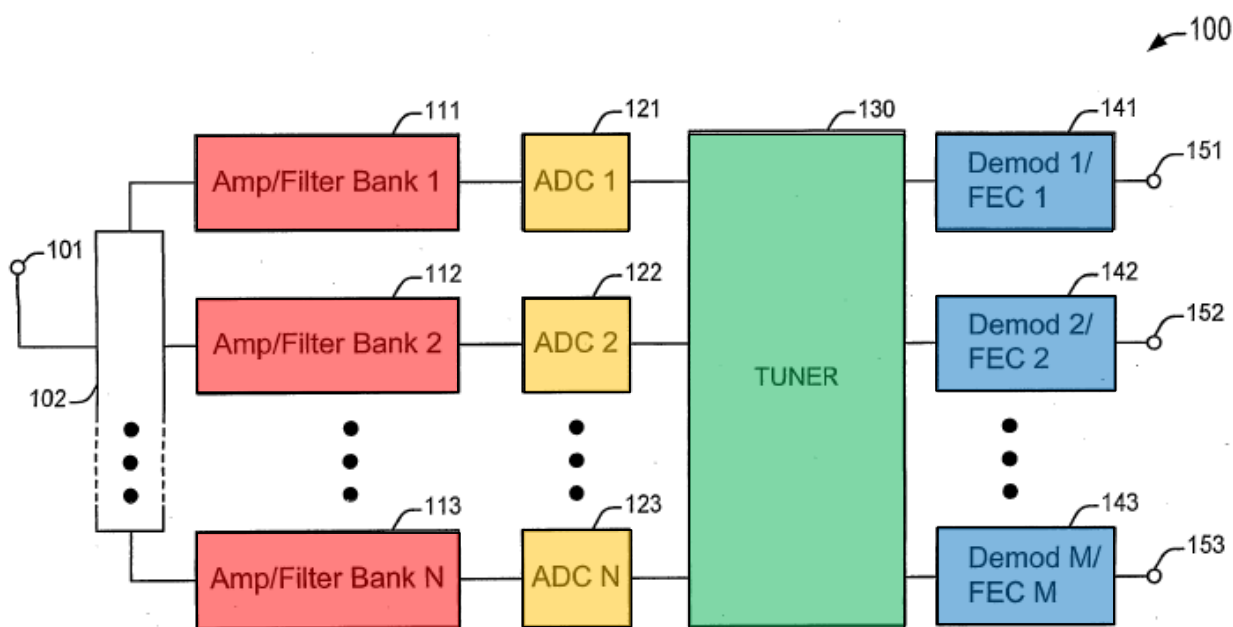


FIG. 1

Ex. 1224, Fig. 1 (annotated)

81. The receiver circuit 100 receives a multichannel analog RF input signal, such as a signal used in a conventional cable television delivery system, received at

input coupler 101. Ex. 1224, [0008], [0024]. That signal is wideband, as it may comprise multiple channels. Ex. 1224, [0009], [0020]-[0023]. The signal can be optionally split. Ex. 1224, [0024]-[0025]. The receiver circuit comprises “a plurality of amplifier-filter banks or circuits 111, 112, 113, a plurality of analog-to-digital converters 121, 122, 123, a digital tuner 130, and a plurality of demodulator circuits 141, 142, 143.” Ex. 1224, [0023].

82. The circuit comprises a plurality of Amp/Filter Banks (**red**) that “segregates the multichannel analog input signal into a plurality of separate analog signals of differing frequency ranges.” Ex. 1224, [0024], [0028]-[0032], [0043]. These signals are undersampled, such that the sampling frequency range of any downstream analog-to-digital converters (ADCs) is reduced. Ex. 1224, [0033]-[0034]. Undersampling, as described in Pugel, is more economical because it reduces the need to supply ADCs supporting high-frequency sampling. Ex. 1224, [0034].

83. Undersampled signals are then converted to digital form in analog-to-digital converters 121-123 (**gold**) “sufficient for satisfactorily processing digital television signals and associated signals intended for end users in a conventional cable television broadcast system.” Ex. 1224, [0036], [0033]-[0037], [0044]-[0045]. The digital signals are received by a digital tuner (**green**) such that “a selected set of digital cable television channels” may be demultiplexed from the digital signals. Ex.

1224, [0038], [0037]-[0039], [0045]. Those demultiplexed channels may then be outputted to one or more demodulators 141-143 (blue), which may perform a variety of demodulation techniques, including quadrature amplitude modulation (QAM) demodulation or quadrature phase shift keying (QPSK) demodulation. Ex. 1224, [0039]-[0040], [0046].

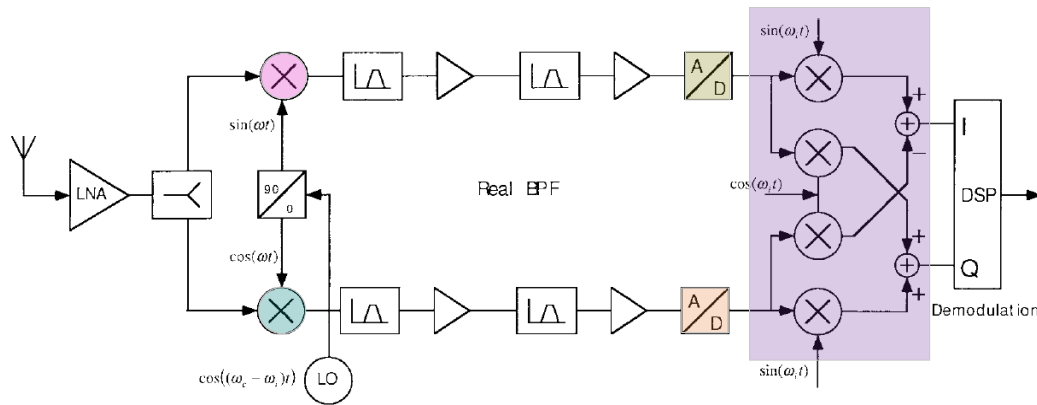
84. It is my opinion that Pugel is in the same field of endeavor as the '866 patent and thus is analogous art. For example, and like the '866 patent, which “relates to wideband receiver systems and methods having a wideband receiver that is capable of receiving multiple radio frequency channels located in a broad radio frequency spectrum,” Pugel relates to a “multi-channel receiver circuit” that “receive[s] a multichannel analog RF input signal.” Ex. 1201, 1:26-29; Ex. 1224, [0009], [0011], [0022]-[0023], Fig. 1. It is also my opinion that Pugel is also reasonably pertinent to problems with which the '866 patent is concerned, and is also analogous art on that basis. For example, the '866 patent describes that “in certain applications such as DVR and picture-in-picture, the receiver system may have to concurrently receive several desired channels” and “an embodiment of the present invention includes a wideband receiver system that is configured to concurrently receive multiple radio frequency (RF) channels including a number of desired channels.” Ex. 1201, 1:49-51, 2:45-48. Pugel similarly describes that “consumers now demand support for simultaneous reception and display of multiple

television channels on a single television screen (e.g., picture-in-picture (PiP)) ... [and] the emergence of personal video recorder (PVR) technology increases the demand for multi-channel reception capability,” and therefore, suggests “a digital television receiver capable of simultaneously receiving a plurality of channels” Ex. 1224, [0005], [0008].

8.6. Crols (Ex. 1225)

85. Crols (Ex. 1225) is a Non-Patent Literature published in March 1998. Crols was publicly available as of April 3, 1998. Ex. 1273, at 44-50, 52. Thus, I understand Crols is prior art under pre-AIA 35 U.S.C. 102(b). I also understand that Crols was not considered during the prosecution of the '866 patent. Ex. 1201, at 1-2.

86. Crols describes various topologies for implementing intermediate frequency (IF) receivers in a telecommunication environment and, in particular, a type of receiver known as a low-IF receiver (illustrated by Figure 22(a) of Ex. 1225 reproduced below). Ex. 1225 at 269, 272. Crols discusses that IF Receivers may create unwanted signals (e.g., a mirror frequency) during downconversion of analog RF signals and discusses techniques to avoid the unwanted signals. Ex. 1225 at 270, 273-274.



Ex. 1225, Fig. 22(a) (annotated)

87. Crols discusses how low-IF receivers can avoid the mirror frequency problem during the downconversion of analog RF signals to IF by downconverting the signals once with a first mixer (**fuchsia**) using a sine signal as input to generate Q components and again with a second mixer (**teal**) using a cosine signal as an input to generate I components. Ex. 1225 at 271-272, 281. The I and Q components have a phase shift of 90° between them. Ex. 1225 at 277. The I and Q components are then digitized separately by two analog-to-digital converters (**olive** and **orange**). Ex. 1225 at 280-281. The digitized I and Q components can be further downconverted to baseband frequency by a complex mixing circuit (**purple**) with four mixers and two adders before forwarding the components to the digital signal processor (DSP) for demodulation. Ex. 1225 at 280-281.

88. It is my opinion that Crols is reasonably pertinent to problems with which the '866 is concerned, and is analogous art to the '866 patent on at least that basis. For example, the '866 patent indicates a circuit wherein an RF signal is

amplified, and the downconverted I and Q signals are generated, prior to digitization by an ADC. Ex. 1201, 4:35-6:15, Fig. 2.

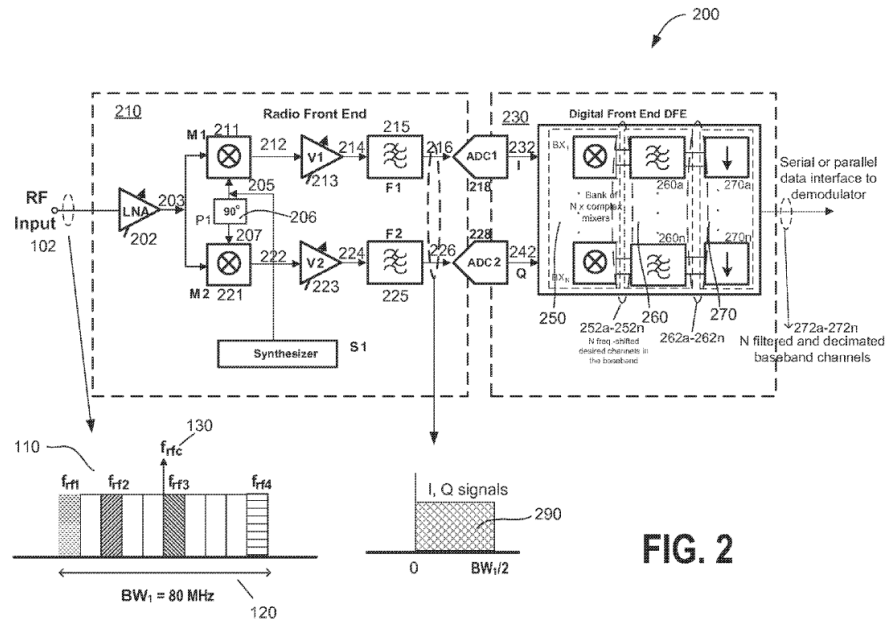


FIG. 2

Ex. 1201, Fig. 2

89. Crols presents circuit diagrams depicting complex bandpass filters consistent with the '866 patent's analog circuit topologies:

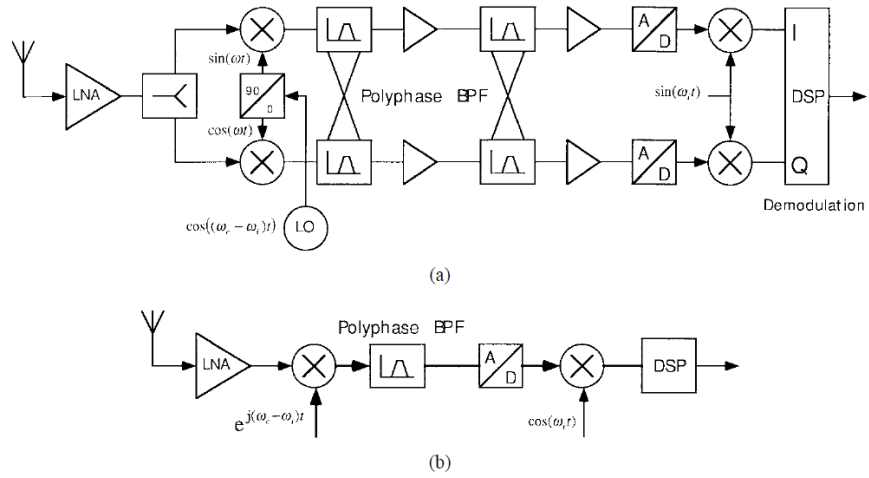


Fig. 21. The topology of a low-IF receiver which uses a complex bandpass filter in the LF part. (a) Full notation and (b) compact notation.

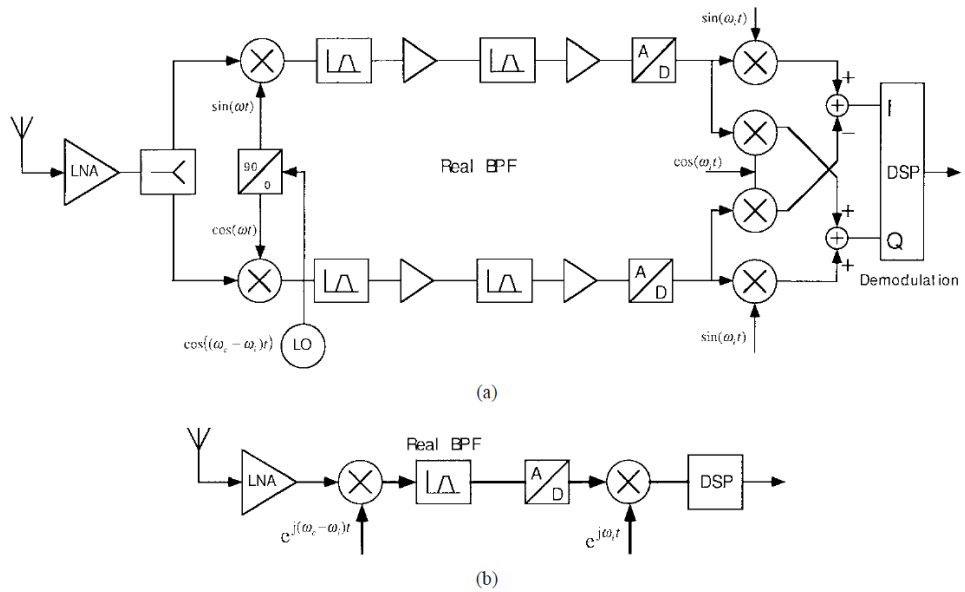


Fig. 22. The topology of a low-IF receiver which uses real filters in the LF part. (a) Full notation and (b) compact notation.

Ex. 1225, Figs. 21-22

Both techniques show ways to suppress unwanted signals as part of downconversion to IF prior to digital processing, providing example implementations for a POSITA looking to build systems in real-world applications. Ex. 1201, 5:17-32; Ex. 1225 at 279-280.

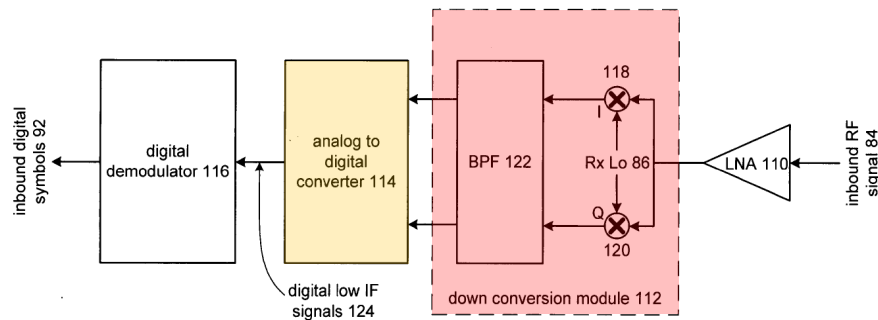
8.7. Chandrakasan (Ex. 1217)

90. Chandrakasan (Ex. 1217) is a Non-Patent Literature published in January 1996. Chandrakasan was publicly available as of April 23, 1996. Ex. 1273 at 35-39, 52. Thus, it is my understanding that Chandrakasan is a prior art under pre-AIA 35 U.S.C. 102(b). Chandrakasan was not considered during the prosecution of the '866 patent. Ex. 1201, at 1-2. Chandrakasan describes the trade-offs between selecting serial time-multiplex architecture and parallel architecture to implement digital signal processing functions. Ex. 1217 at 354-356. Parallel architectures comprise “one to one correspondence between the operations on the signal flow graph” and “require a small or no controller.” Ex. 1217 at 354-355. However, when there is a constraint in the circuit area, serial time-multiplexed architectures may be preferred where “multiple operations on a signal flowgraph can be mapped onto the same functional hardware unit.” Ex. 1217 at 355.

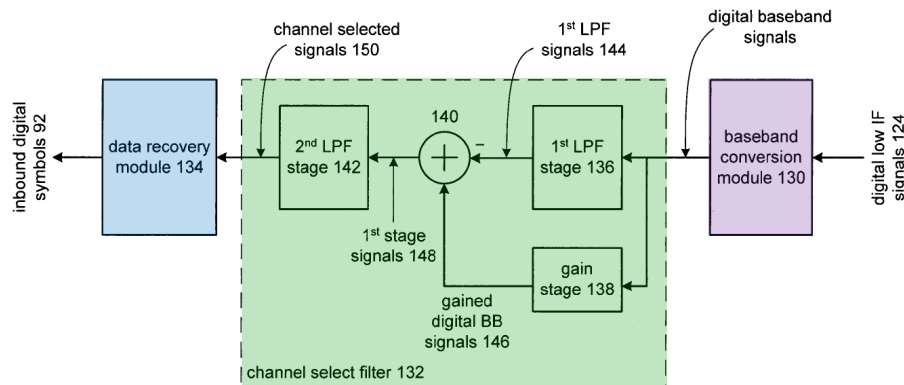
91. Chandrakasan is reasonably pertinent to problems with which the '866 is concerned, and is analogous art to the '866 patent on at least that basis. Both techniques represent well-known approaches to signal transmissions in digital systems, providing example implementations for a POSITA looking to build systems in real-world applications. Ex. 1217 at 352; Ex. 1201, 7:10-19.

8.8. U.S. Publication No. 2006/0029170 – Jensen '170 (Ex. 1230)

92. Jensen '170 (U.S. Pub. No. 2006/0029170, Ex. 1230) is a U.S. Published Application published on February 9, 2006. Thus, I understand that Jensen '170 is prior art under pre-AIA 35 U.S.C. 102(b). It is my understanding that Jensen '170 was not considered during the prosecution of the '866 patent. Ex. 1201, at 1-2.



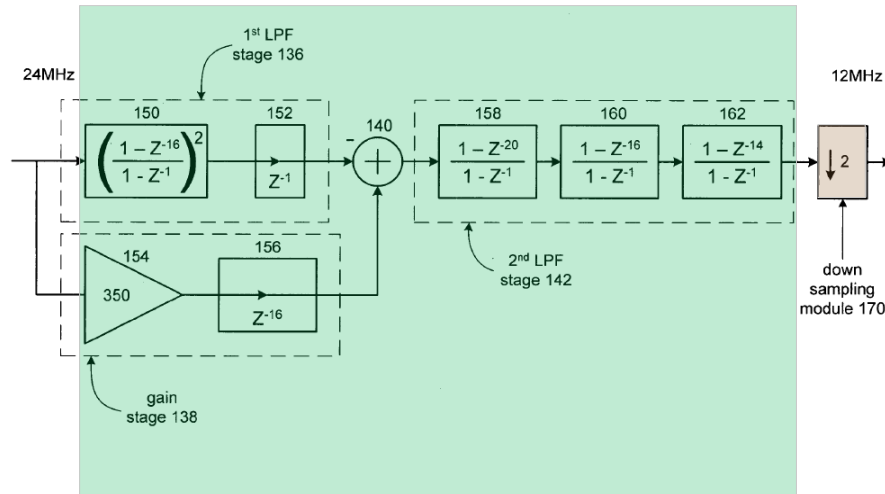
Ex. 1230, Fig. 8 (annotated)



Ex. 1230, Fig. 9 (annotated)

93. Jensen '170 describes a radio receiver (illustrated in Jensen '170 Figures 8 and 9 reproduced above annotated with colors referenced in the discussion below) that comprises a down-conversion module 112 (**red**), an analog to digital converter 114 (**gold**), a baseband conversion module 130 (**purple**), a channel select

filter 132 (**green**), and a data recovery module 134 (**blue**). Ex. 1230, [0060]-[0068], Figs. 8-9. The down-conversion module 112 includes mixers 118 and 120 that mix the inbound RF signals 84 with in-phase (I) and quadrature (Q) components of a receiver local oscillator to produce in-phase intermediate frequency (IF) mixed signals and quadrature IF mixed signals. Ex. 1230, [0060]-[0061]. The analog-to-digital converter 114 converts the in-phase IF mixed signals and quadrature IF mixed signals to digital IF signals 124. Ex. 1230, [0062]. The baseband conversion module 130 converts the digital IF signals 124 into digital baseband signals. Ex. 1230, [0065]. The channel-select filter 132 includes a first low pass filter stage 136, a gain stage 138, a subtraction module 140, and a second low pass filter stage 142, which in combination (**green**) filters channel-selected signals 150 from the digital baseband signals. Ex. 1230, [0008]-[0009], [0017], [0060], [0064]-[0068]. The first low pass filter stage 136 and the second low pass filter stage 142 are implemented with finite impulse filters. Ex. 1230, [0010], [0071]-[0073]. The data recovery module 134 converts the channel-selected signals 150 into inbound digital symbols 92. Ex. 1230, [0068].



Ex. 1230, Fig. 15 (annotated)

94. Jensen '170 further describes that the channel select filter 132 may further include a down-sampling module 170 (**brown**), which reduces the sampling rate of the signals of the selected channel to produce down-sampled signals for the data recovery module 134 of the RF receiver. Ex. 1230, [0074]-[0075].

95. It is my opinion that Jensen '170 is reasonably pertinent to problems with which the '866 patent is concerned (as well as to problems with which Pugel is concerned), and is analogous art to the '866 patent (and to Pugel) on that basis. For example, similar to Jensen '170, the '866 patent describes a receiver that generates downconverted I and Q components of a received RF signal in the analog domain, digitizes those signals, downconverts the digital signals to baseband, filters out desired digital signals, and then decimates the desired digital signals. Ex. 1201, 4:35-7:16, Figs. 2-3; Ex. 1230, [0060]-[0068], [0074]-[0075], Figs. 8-9. Jensen '170 and the '866 patents both describe using channel select filters to filter out desired

digital signals and implementing the channel select filters based on digital architectures of FIR filters. Ex. 1201, 7:4-9, 8:2-4; Ex. 1230, [0010], [0064]-[0066], [0071]-[0073].

8.9. U.S. Publication No. 2008/0120667 – Zaltsman (Ex. 1274)

96. Zaltsman (U.S. Publication No. 2008/0120667, Ex. 1274) is a U.S. Patent Application Publication published May 22, 2008. As the publication date is more than a year prior to the earliest priority date of the '866 patent claims against which it is asserted herein, it is my understanding that Zaltsman is prior art under pre-AIA 35 U.S.C. § 102(b). Further, in view of its October 29, 2007, priority date, Zaltsman is prior art under pre-AIA 35 U.S.C. § 102(e) as to all claims. It is my understanding that Zaltsman was not considered during the prosecution of the '866 patent. Ex. 1201, at 1-2.

97. Zaltsman discloses a cable gateway system and architecture incorporating a hybrid digital video transceiver. Ex. 1274, Abstract, [0024]-[0036]. Zaltsman provides a detailed background section discussing known technology as of 2007, particularly regarding the use of digital television standards, including using DOCSIS in wideband television transmission to a set-top receiver. Ex. 1274, [0003]-[0023]. In particular, Zaltsman states that, in the latest DOCSIS standard of the day, multiple television channels were bonded together, typically using a 6 MHz frequency band. Ex. 1274, [0012]-[0013].

98. It is my opinion that Zaltsman is reasonably pertinent to problems with which the '866 is concerned, and is analogous art to the '866 patent on at least that basis. Zaltsman describes cable systems for transmitting digital data signals using RF signals and QAM, similar to the '866 patent, and a POSITA would turn to Zaltsman when looking for technical details known in the art for such systems. Ex. 1274, Abstract, [0003]-[0023], [0024]-[0036]; Ex. 1201, 1:26-56, 2:45-3:67, 8:54-9:8.

9. OPINIONS WITH RESPECT TO THE '866 PATENT

9.1. Grounds A0 and A1: Pugel

99. In the following, I provide an element-by-element analysis showing how Pugel alone anticipates and renders obvious claims 27-28, 33, 37, 39-42, 47, 51, 53-56, 61, 65, 67-70, 75, 79, and 81-82. 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.

9.1.1. Independent Claim 27

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

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

101. To the extent the preamble is limiting, it is my opinion that Pugel discloses “[a] cable television (TV) comprising:” as claimed.

102. Pugel teaches a multichannel receiver circuit that is capable of “simultaneous reception of a plurality of digital television channels” and “recover[] ... a wide variety of digital content,” such that devices such as “television receivers, PVR’s, or other devices” may receive those recovered digital content. Ex. 1224, [0008]-[0009], [0048]-[0049].

103. As discussed in Section 8.3, it was well-known to a POSITA before the earliest priority date of the ’866 patent that consumer terminal equipment (e.g., television receivers, set-top boxes, digital video recorders, personal video recorders, and other terminal equipment) included receivers or receiver circuits that received RF signals of multiple cable television channel and selected signals for certain desired cable television channels for output. *See also* Ex. 1224, [0008]-[00013], [0048]-[0049]. Therefore, it is my opinion that a POSITA would thus have understood that Pugel’s multichannel receiver circuit, combined with a DVR, is a “cable television (TV) device” recited in Element [27A].

104. Thus, it is my opinion that Pugel teaches Element [27A].

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

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

106. As discussed in Section 9.1.1.a, Pugel teaches a multichannel receiver circuit that is capable of “simultaneous reception of a plurality of digital television channels” via a multichannel analog RF input signal. Ex. 1224, [0008]-[0013], [0023]-[0024], [0028]. The digital tuner 130 in Pugel’s multichannel receiver circuit includes a channel selector 315 that permits users to select one or more digital television channels “desired to be recovered” by the users, and the digital tuner 130 demultiplexes only the selected digital television channels. Ex. 1224, Abstract, [0001], [0008]-[0009], [0011], [0022], [0028], [0036]-[0044], [0048]-[0049]. I would understand that the selected digital television channels are “desired” by the users. Additionally, I would also understand that the example multichannel analog RF input signal described in Pugel (ranging from about 5 MHz to about 900 MHz, the claimed “contiguous band of frequencies in an input signal”) includes more digital television channels than those selected by the users, and these other channels can be understood as “undesired” digital channels that are present in the

multichannel analog RF input signal but not selected by the users. *See* Section 8.1, *supra* (citing Ex. 1233 at 27, 852, 985-990). My understanding of “desired” and “undesired” digital television channels in Pugel is consistent with the use of “desired” and “undesired” in the ’866 patent. Ex. 1201, Abstract, 1:29-34, 3:9-39, 4:19-33, 5:41-44, 5:49-61, 6:32-42, 6:55-64.

107. Pugel’s receiver circuit includes analog-to-digital converters (ADCs) 121, 122, 123 (gold) “sufficient for satisfactorily processing digital television signals and associated signals intended for end users in a conventional cable television broadcast system.” Ex. 1224, [0033]-[0037], [0044]-[0045], Fig. 1.

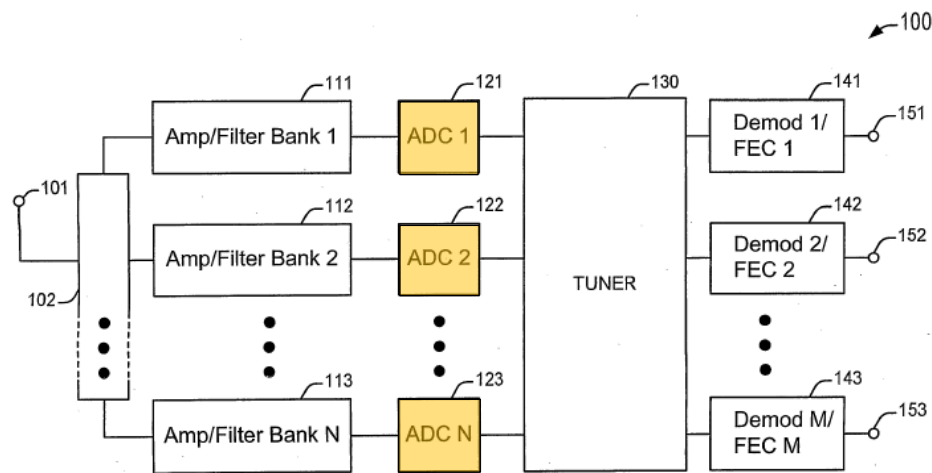


FIG. 1

Ex. 1224, Fig. 1 (annotated)

108. Pugel describes receiving a multichannel analog RF input signal and splitting the multichannel analog RF input signal into multiple analog bands by using the amplifier-filter circuits 111, 112, 113. Ex. 1224, Abstract, [0001], [0008]-[0009],

[0011], [0022], [0024]-[0025], [0028], [0036]-[0044], [0048]-[0049]. As an example, Pugel discusses receiving a multichannel analog RF input signal ranging from about 5 MHz to about 900 MHz, and splitting the multichannel analog RF input signal into three analog bands (the first analog band ranging from 5 to 300 MHz, the second analog band ranging from 300 to 600 MHz, and the third analog band ranging from 600 to 900 MHz). Ex. 1224, [0024]-[0026], [0028], [0034]. Each of the analog bands is then outputted to a different ADC for converting the analog band of analog signals to a digital band of digital signals, and each ADC may comprise a frequency selector “for setting the sampling frequency and/or input frequency corresponding to the desired band.” Ex. 1224, [0024], [0034], [0035].

109. As I explain in Section 6.2, the '866 patent implicitly defines “wideband” as a band that carries multiple channels, and this definition of “wideband” is consistent with the ordinary and customary meaning of “wideband.” Ex. 1201, 1:36-38. If each television channels are allocated 6 MHz of frequency bandwidth in the RF frequency spectrum, it is my opinion that a POSITA would consider the three analog bands produced by Pugel’s amplifier-filter circuits 111, 112, 113 to be also wideband as they also comprise signals of multiple cable televisions, and that each analog band may comprise a combination of desired and undesired television channels or all undesired television channels.

110. It is my opinion that a POSITA would consider each of Pugel's ADCs as a "wideband" ADC as it is digitizing a wideband signal (i.e., an analog band that has a width of a 300MHz band and comprises multiple channels). *Compare Ex. 1224, [0034]-[0036] with Ex. 1201, 1:24-27.* Pugel discloses that the bands of frequencies may be contiguous or non-contiguous. Ex. 1224, [0043]. Pugel's ADCs are structurally equivalent to, and perform the same function as, the structure described by the '866 patent for performing the function recited in Element [27B] (e.g., ADC1 218 and ADC2 228). Ex. 1201, 5:28-31.

111. Thus, it is my opinion that Pugel teaches Element [27B].

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

112. It is my opinion that Pugel in view of Crols discloses "a digital frontend (DFE) coupled to the wideband ADC, wherein the DFE is configured to concurrently select and provide each of the plurality of desired channels without providing any of the plurality of undesired channels," as claimed.

113. Pugel's receiver circuit comprises a digital tuner 130 (the claimed "digital frontend (DFE)") (**green**) configured to select a plurality of desired television channels from the digital bands that were outputted by the ADCs 121, 122, 123 such that "a selected set of digital cable television channels" may be

demultiplexed from the digital signals. Ex. 1224, [0038], [0037]-[0039], [0045], Fig. 1. The digital tuner 130 in Pugel's multichannel receiver circuit includes a channel selector 315 that permits users to select one or more digital television channels "desired to be recovered" by the users, and the digital tuner 130 demultiplexes only the selected digital television channels and does not allow unselected digital television channels to be outputted. Ex. 1224, Abstract, [0001], [0008]-[0009], [0011], [0022], [0028], [0036]-[0044], [0048]-[0049]. The digital tuner 130 may include digital multiplexers, demultiplexers, or "a multitude of components configured as is well known in the art to recover a plurality of digital channel signals substantially simultaneously using a plurality of separate digital processors or a single digital processor." Ex. 1224, [0037].

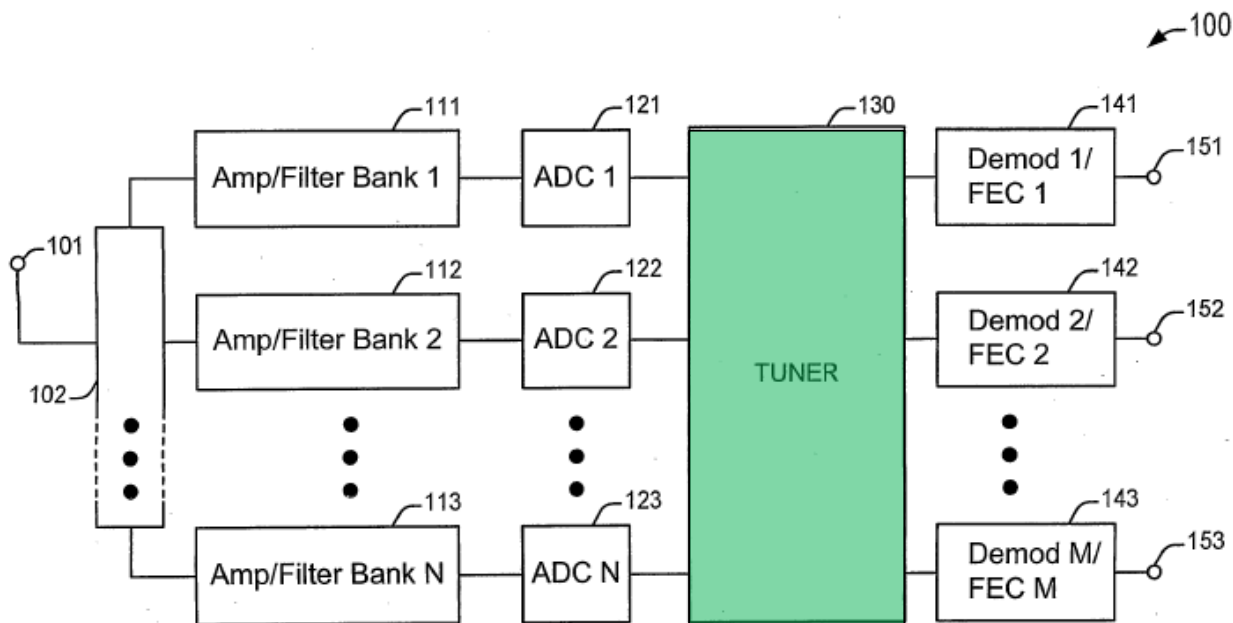


FIG. 1

Ex. 1224, Fig. 1 (annotated)

114. For example, Pugel teaches that the digital tuner may select and only demultiplex digital channels corresponding to certain pay-per-view selections, or may demultiplex all channels. Ex. 1224, [0038]. In such an example, the selected digital channels are the claimed “desired television channels,” and the channels that are not selected are “undesired channels.” The digital tuner may perform a variety of other functions, including “coding, decoding, scrambling, descrambling, rotating, and/or derotating operations prior to passing the digital channel signals to demodulation circuits.” Ex. 1224, [0039].

115. Thus, it is my opinion that Pugel teaches Element [27C].

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

116. It is my opinion that Pugel discloses “wherein the cable TV device comprises a digital video recorder (DVR),” as claimed.

117. Pugel teaches that its system may comprise “a PVR device” for receiving digital video signals. Ex. 1224, [0048]-[0049]. 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. 1251, [0018] (“A PVR is also referred to as [] digital video recorder (DVR)”); Ex. 1252, [0048], [0060] (“Digital Video Recorders (DVRs, also known as Personal Video Recorders, PVRs)”).

118. To any extent that Pugel does not explicitly disclose that Pugel’s multichannel receiver circuit may be located in a device that also comprises a DVR, or Pugel’s multichannel receiver circuit may be located in a DVR, it is my opinion that it was well-known to a POSITA before the earliest priority date of the ’866 patent that consumer terminal equipment (e.g., television receivers, set-top boxes, digital video recorders, personal video recorders, and other terminal equipment) included receivers or receiver circuits that received RF signals of multiple cable television channel and selected signals for certain desired cable television channels for output. *See* Sections 8.1, 8.2, 8.3 *supra*. Therefore, it is my opinion that it would

have been obvious to a POSITA to co-locate the Pugel's multichannel receiver circuit and a DVR into the same device, such as a set-top box, as it would allow for a more feature-filled device and would be more cost-efficient. *See id.* Incorporating Pugel's multichannel receiver circuit and a DVR into the same device (e.g., set-top box) would be nothing more than applying a known technique (placing an RF receiver and a DVR together) to a known device (a set-top box) ready for improvement to yield predictable results (a single device with DVR and multichannel tuning functionality, as taught by Pugel). A POSITA would have a reasonable expectation of success, as Pugel expressly teaches co-locating both elements into a single device, which would have been well within the skill of a POSITA.

119. It is also my opinion that it would also be obvious to a POSITA that Pugel's multichannel receiver circuit may be a part of a DVR. For example, Pugel provides an express teaching that "[m]any PVR's include the ability to tune one or more channels for viewing, while simultaneously tuning one or more additional channels for recording to a recording medium." Ex. 1224, [0005]. It would have been obvious to a POSITA that a DVR for tuning and recording multiple channels, as taught by Pugel, could be implemented using the multichannel receiver circuit, including a tuner as also taught by Pugel. Nothing in Pugel forecloses that a DVR and receiver circuit could be co-located. And co-locating the bundled receiver

circuit/DVR device would still be consistent with Pugel's other teachings, as the device could then send additional tuned signals to other devices (e.g., receivers or other DVRs) throughout the home. *See* Ex. 1224, [0049]. This would have the benefit of being more cost-efficient for the consumer, as the consumer could buy a bundled receiver circuit/DVR device to start, and then purchase further devices in their home compatible with the receiver circuit later. This would be nothing more than applying a known technique (incorporating an RF receiver circuit into a PVR, as taught by Pugel) to a known device (Pugel's PVR) ready for improvement to yield predictable results (a single device with DVR and multichannel tuning functionality, as taught by Pugel). A POSITA would have a reasonable expectation of success, as Pugel expressly teaches DVRs incorporating RF receivers and co-locating both elements into a single device, which would have been well within the skill of a POSITA.

120. Thus, it is my opinion that Pugel teaches Element [27D].

9.1.2. Independent Claim 41

[41A] “A cable TV device comprising:”

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

[41C] “a plurality of digital down converters coupled to the wideband ADC, wherein each digital down converter, of the

plurality of digital down converters, is operable to generate a digital channel output corresponding to each desired channel, of the plurality of desired channels, and”

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

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

122. Elements [41A]-[41D] recite similar features as Elements [27A]-[27D], except that [27B] recites “a wideband analog-to-digital converter (ADC) configured to digitize a contiguous band of frequencies in an input signal, wherein the contiguous band of frequencies comprises a plurality of desired channels and a plurality of undesired channels,” while [41B] recites “a wideband analog-to-digital converter (ADC) configured to digitize an input signal, wherein the input signal comprises a plurality of desired channels and a plurality of undesired channels,” (emphasis added). Furthermore, [27C] recites “DFE is configured to concurrently select and provide each of the plurality of desired channels,” while [41C] recites “a plurality of digital down converters ..., wherein each digital down converter ... is operable to generate a digital channel output corresponding to each desired channel.”

123. To the extent there is any difference between “configured to digitize a contiguous band of frequencies in an input signal” in [27B] and “configured to digitize an input signal” in [41B], it is my opinion that both limitations are taught

for the same rationale discussed above in Section 9.1.1.b. *See also* Section 8.1, *supra* (citing Ex. 1233 at 45, 413, 515-520).

124. Regarding the “plurality of digital down converters,” it is my opinion that the “plurality of digital down converters” is just another name for the structure called a “DFE” in limitation [27C]. For example, as I explained in Section 6.3, a POSITA would have understood that the plain and ordinary meaning of “digital down converter” as used in the ’866 patent includes at least the components in one signal path in the DFE, i.e., a complex mixer 250 and a filter 260, and optionally: a demodulator, a serial interface, or a parallel interface.

125. As discussed above in Section 9.1.1, Pugel’s digital tuner 130 receives, via a channel selector 315 coupled to the digital tuner 130, selections of one or more television channels desired by users. Ex. 1224, [0038]. Pugel’s digital tuner 130 is configured to select the signals of the desired television channels from “digital signals converted by the plurality of analog-to-digital converters 121, 122, 123” and output the selected digital channels to demodulation circuits 141, 142, 143. Ex. 1224, [0037]-[0039]. The digital signals from Pugel’s analog-to-digital converters 121, 122, 123 include signals of both desired and undesired television channels. *See* Section 9.1.1, *supra*. Pugel’s digital tuner 130 only outputs the signals of the desired television channels to the demodulation circuits 141, 142, 143. Ex. 1224, [0039].

Pugel further elaborates that the digital tuner 130 can be implemented with one or more digital signal processors. Ex. 1224, [0037].

126. Before selecting the signals of the desired television channels from the digital signals produced by the analog-to-digital converters 121, 122, 123, Pugel's digital tuner 130 downconverts the digital signals. Ex. 1224, [0037], claims 14 (reciting "digital processor (130) ... downconverts said multiplexed signal and extracts desired information to be coupled to said first and second demodulator circuits"), 15 (reciting "digital processor (130) downconverts and extracts desired information to be coupled to said first and second demodulator circuits (141, 142)"), 18 (reciting "downconverting said first digital signal and said second signal ... and ... extracting desired television program information from said downconverted first digital signal and said second digital signal"), 20-21.

127. Pugel does not expressly disclose in detail the components inside the digital tuner 130 that perform the downconversion process followed by the selection process. However, Pugel suggests that the digital tuner may include "a multitude of components configured as is well known in the art to recover a plurality of digital channel signals substantially simultaneously." Ex. 1224, [0037]. Therefore, it is my opinion that it would have been obvious to a POSITA in view of Pugel's express teachings that digital tuner 130 performs the same functions as the "plurality of digital down converters" in limitation [41C].

128. Moreover, to the extent “digital down converter” (which is not recited in the ’866 patent specification and figures) is construed to be a means-plus-function term, Pugel’s digital tuner 130 performs the (1) identical function, (2) in substantially the same way (3) with substantially the same result, as the disclosed structure in the ’866 patent. For example, both Pugel’s digital tuner 130 and the claimed “plurality of digital down converters” of the ’866 patent downconvert digital signals received from ADCs and select signals of desired channels from the digital signals. *Compare* Ex. 1224, [0036]-[0039], claims 14-15, 18, 20-21 *with* Ex. 1201, 5:48-59, 6:43-54, Fig. 2 (filters 260).

129. Therefore, it is my opinion that elements [41A]-[41D] are thus disclosed and taught as obvious by Pugel for the same reasons discussed above with respect to elements[27A]-[27D]. *See* 9.1.1.a-d, *supra*.

9.1.3. Independent Claim 55

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

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

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

[55D] “wherein the cable TV device is operable to configure at

least some of the plurality of desired channels as an output for a picture-in-picture display.”

130. The elements of claim 55 appear in the Claims Listing Appendix, labeled as elements [55A]-[55D]. For the following reasons, it is my opinion that elements [55A]-[55D] are anticipated and rendered obvious by Pugel.

131. Elements [55A]-[55C] recite similar features as Elements [27A]-[27C] and are thus disclosed and taught as obvious by Pugel for the same reasons discussed above with respect to Elements [27A]-[27C]. *See* Section 9.1.1.a-c, *supra*.

132. Regarding Element [55D], Pugel teaches that its system is designed to support a television displaying multiple channels on the same television using a picture-in-picture (PiP) display. Ex. 1224, [0005], [0048]-[0049]. Pugel teaches that PiP demands support for the simultaneous reception of multiple television channels. *Id.* And a POSITA would have understood that an advantage of Pugel’s multichannel receiver is that it supports the output of multiple television channels to support such a PiP system when “traditional solutions lack the flexibility required.” Ex. 1224, [0005]. To any extent not explicitly disclosed by Pugel, it would have been obvious to a POSITA in view of Pugel’s express teachings that a device, such as Pugel’s multichannel receiver circuit, would be configured to output a plurality of desired channels for use in a PiP display in the home. A POSITA would understand the benefits of such a configuration because it would support the display of PiP material from Pugel’s multichannel receiver circuit, as taught by Pugel. This would have been

nothing more than applying a known technique (generation of multiple data streams for PiP display) to a known device (Pugel's multichannel receiver circuit) ready for improvement to yield predictable results (the output of the Pugel's multichannel receiver circuit could be used for PiP display). A POSITA would have a reasonable expectation of success, as Pugel's multichannel receiver circuit is designed to output a plurality of desired channels, and any necessary modification would have been well within the skill of a POSITA.

133. As such, it is my opinion that claim 55 is anticipated and rendered obvious based on Pugel.

9.1.4. Independent Claim 69

[69A] “A cable TV device comprising:”

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

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

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

134. The elements of claim 69 appear in the Claims Listing Appendix, labeled as elements [69A]-[69D]. For the following reasons, it is my opinion that claim 69 is anticipated and rendered obvious by Pugel.

135. Elements [69A]-[69C] recite similar features as elements [41A]-[41C] and are directed to substantially the same subject matter as Elements [27A]-[27C]. Thus, it is my opinion that Elements [69A]-[69C] are anticipated and rendered obvious by Pugel for the same reasons discussed above with respect to Elements [27A]-[27C] and Elements [41A]-[41C]. *See* Sections 9.1.1.a-c, 9.1.2, *supra*.

136. Element [69D] is identical to Element [55D] and thus is anticipated and rendered obvious by Pugel for the same reasons discussed above with respect to Element [55D]. *See* Section 9.1.3, *supra*.

9.1.5. Dependent Claims 28, 42, 56, and 70

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

137. It is my opinion that Pugel discloses the “cable TV device of claim [27/41/55/69], wherein ... the cable TV device comprises a cable network connector, and the input signal is operably communicated from the cable network connector to the wideband ADC via at least one of an analog amplifier and an analog filter,” as recited in claims 28, 42, 56, and 70.

138. Pugel teaches the claimed “a cable network connector” comprising an input coupler 101 (**green**) for a multichannel analog RF input signal, and optionally a splitter 102, that connects the input signal to a plurality of amplifier-filter circuits (**red**), which in turn connect to a plurality of ADCs (**gold**). Ex. 1224, [0025]-[0026], [0029]-[0031], [0042]-[0044], Figs. 1-2. The contents of Pugel’s Amp/Filter Bank in Figure 1 are shown in Pugel’s Figure 2. The amplifier-filter circuits comprise at least one analog amplifier (e.g., amplifier 201, **purple**) and analog filter (e.g., bandpass filter 202, **pink**). Ex. 1224, [0029]-[0031], Fig. 2.

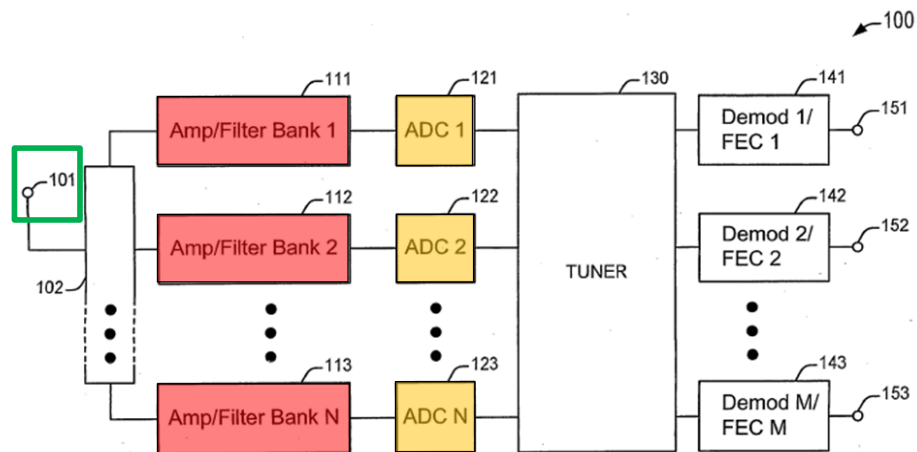


FIG. 1

Ex. 1224, Fig. 1 (annotated)

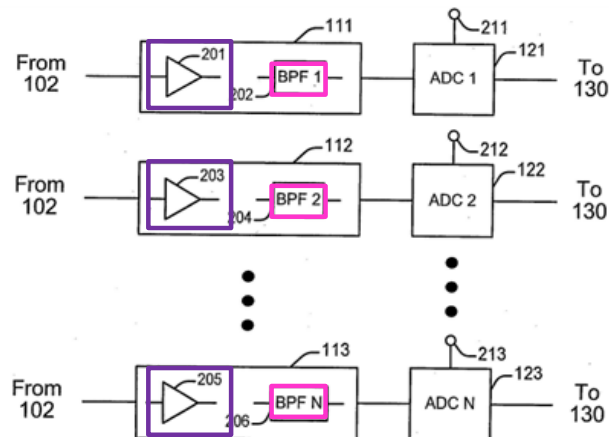


FIG. 2

Ex. 1224, Fig. 2 (annotated)

139. As such, it is my opinion that Pugel anticipates and renders obvious claims 28, 42, 56, and 70.

9.1.6. Dependent Claims 33, 47, 61, and 75

[33/61] “The cable TV device of claim [27/55], wherein: the DFE comprises a plurality of digital demodulators, and each digital demodulator, of the plurality of digital demodulators, is operable to demodulate a desired channel, of the plurality of desired channels.”

[47/75] “The cable TV device of claim [41/69], wherein: each digital down converter comprises a digital demodulator operable to demodulate a desired channel, of the plurality of desired channels, to provide a demodulated channel as the digital channel output.”

140. It is my opinion that Pugel discloses the features of claims 33, 47, 61, and 75.

141. As I explained in Section 9.1.1.b, the input to Pugel’s multichannel receiver circuit corresponds to all received television channels, including desired and

undesired television channels. Ex. 1224, Abstract, [0001], [0008]-[0009], [0011], [0022], [0028], [0036]-[0044], [0048]-[0049]. Pugel teaches the digital tuner 130 comprising a channel selector 315 for selecting channels to be demultiplexed, wherein a channel selected by the digital tuner is desired, and a channel unselected by the digital tuner is undesired. *Id.* This is consistent with the use of “desired” and “undesired” in the ’866 patent. Ex. 1201, Abstract, 1:40-45, 3:25-56, 4:38-53, 5:56-65, 6:3-15, 6:53-63, 7:10-19.

142. As I further explained in Section 9.1.2, it is my opinion that the “plurality of digital down converters” is just another name for the structure called a “DFE” in limitation [27C]. For example, as I explained in Section 6.3, a POSITA would have understood that the plain and ordinary meaning of “digital down converter” as used in the ’866 patent includes at least the components in one signal path in the DFE, i.e., a complex mixer 250 and a filter 260, and optionally: a demodulator, a serial interface, or a parallel interface.

143. Pugel teaches outputting the selected, demultiplexed desired channels output from digital tuner 130 and forwarding them to one or more demodulators 141-143 (blue). Ex. 1224, [0040]. Pugel suggests that each demodulator can receive and demodulate one of the selected desired channels outputted by the digital tuner 130. Ex. 1224, [0010] (“the plurality of demodulator circuits including at least a first demodulator circuit configured to receive and demodulate a first channel of the

plurality of digital RF channels and a second demodulator circuit being configured to receive and demodulate a second channel of the plurality of digital RF channels”), [0046] (“[i]n step 406, the first digital RF channel signal is demodulated and forward-error-corrected. [i]n step 407, the second digital RF channel signal is demodulated and forward-error-corrected. [s]teps 406 and 407 may be accomplished using demodulation circuits 141, 142, 143.”). Thus, Pugel’s digital tuner outputs multiple desired digital television channels where each demodulator can demodulate one of the desired digital television channels.

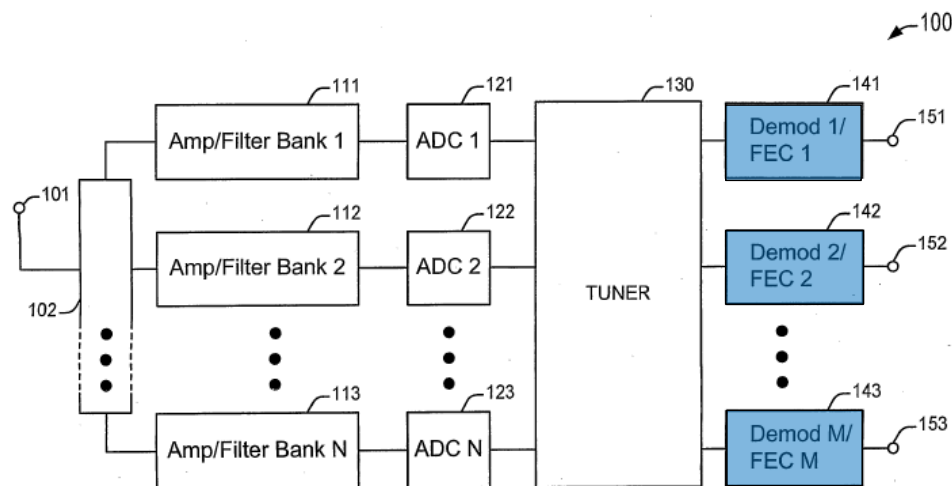


FIG. 1

Ex. 1224, Fig. 1 (annotated)

144. Pugel further teaches that the digital tuner 130 “may perform coding, decoding, scrambling, descrambling, rotating, and/or derotating operations prior to

passing the digital channel signals to demodulation circuits 141, 142, 143.” Ex. 1224, [0039]. The demodulated signal is then provided as a digital channel output at one or more output couplers 151-153. Ex. 1224, [0010]-[0012], [0027], [0039]-[0041], [0046], Figs. 3-4.

145. Regarding the number of demodulators, while Figure 1 shows multiple demodulators, Pugel expressly teaches that “the present invention is not so limited and any number of ... demodulator circuits may be used in accordance with the present invention.” Ex. 1224, [0023]. Moreover, Pugel expressly teaches that “the number (1 . . . M) of demodulator circuits provided is not necessarily related to the number (1 . . . N) of amplifier-filter circuits and/or analog-to-digital converters provided.” Ex. 1224, [0023], [0027], [0040].

146. To the extent it is argued that Pugel does not explicitly teach “the DFE comprises a plurality of digital demodulators” and “each digital down converter comprises a digital demodulator,” Pugel teaches that both the digital tuner 130 and the demodulation circuits 141, 142, 143 can be implemented using one or more digital signal processors. Ex. 1224, [0037], [0046]. It is my opinion that a POSITA would understand that a single processor may be used to implement both the digital tuner 130 and all the demodulation circuits. This would have been nothing more than applying a known technique (implementing the functions of signal processing such as channel selection of demodulation of the selected channel in a digital signal

processor) to a known device (Pugel's receiver circuit where the digital tuner and the demodulation circuits are implemented in digital signal processors) ready for improvement to yield predictable results (using one digital signal processor may save chip area and lower power consumption).

147. As such, it is my opinion that Pugel teaches the limitations of claims 33, 47, 61, and 75.

9.1.7. Dependent Claims 37, 51, 65, and 79

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

148. It is my opinion that Pugel discloses the features of claims 37, 51, 65, and 79.

149. Pugel's system is "sufficient for satisfactorily processing digital television signals and associated signals intended for end users in a conventional cable television broadcast system." Ex. 1224, [0033]-[0037], [0044]-[0045]; *See also* Ex. 1224, Abstract ("[t]his combination of components permits substantially simultaneous reception of multiple digital cable channels within a single digital receiver circuit suitable for use with conventional cable delivery systems and at a reasonable cost."). Therefore, Pugel teaches tuning desired channels comprising one or more cable broadcast channels. Ex. 1224, [0037]-[0039], [0045].

9.1.8. Dependent Claims 39, 53, 67, and 81

[39/53] “The cable TV device of claim [27/41], wherein: the cable TV device is operable to configure at least some of the plurality of desired channels as an output for a picture-in-picture display.”

[53] “The cable TV of claim 41, wherein: the cable TV device is operable to provide a picture-in-picture display according to the plurality of digital channel outputs.”

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

150. It is my opinion that Pugel discloses the features of claims 39, 53, 67, and 81.

151. Claims 39 and 53 recite features similar to those in Element [55D], and claims 67 and 81 recite features similar to those in Element [27D]; therefore, it is my opinion that Pugel discloses or teaches the features of 39, 53, 67, and 81. *See* Sections 9.1.1.d, 9.1.3, *supra*.

9.1.9. Dependent Claims 40, 54, 68, and 82

[40/68] “The cable TV device of claim [27/55], wherein: the contiguous band of frequencies comprises a portion of a frequency spectrum of the input signal.”

[54/82] “The cable TV device of claim [41/69], wherein: the plurality of desired channels and the plurality of undesired channels comprise a portion of a frequency spectrum of the input signal.”

152. It is my opinion that Pugel discloses the features of claims 40, 54, 68, and 82.

153. The Pugel multichannel receiver circuit comprises a “plurality of amplifier-filter banks or circuits 111, 112, 113 [red] ... configured to process frequencies within a specified band.” Ex. 1224, [0028], Figs. 1-2. Pugel contemplates that the amplifier-filter banks may act as bandpass filters that will process bands of limited frequency ranges for input to different analog-to-digital converters (ADCs). Ex. 1224, [0025]-[0032], Figs. 1-2. For example, Pugel describes splitting the multichannel analog RF input signal, ranging from about 5 MHz to about 900 MHz and comprising both desired and undesired television channels, into three analog bands by using the amplifier-filter circuits 111, 112, 113; the amplifier-filter circuit 111 processes the first analog band ranging from 5 to 300 MHz, the amplifier-filter circuit 112 processes the second analog band ranging from 300 to 600 MHz, and the amplifier-filter circuit 113 processes the third analog band ranging from 600 to 900 MHz. Ex. 1224, [0024]-[0026], [0028], [0034].

154. The analog signals in the analog bands processed by the amplifier-filter circuits 111, 112, 113 are converted to digital signals by the ADCs 121, 122, 123. Ex. 1224, [0024]. For example, the first band of 5 MHz to 300 MHz is digitized by ADC 121, the second band of 300 MHz to 600 MHz is digitized by ADC 122, and the third band of 600 MHz to 900 MHz is digitized by ADC 123. Ex. 1224, [0033]-[0034]. Therefore, each ADC in Pugel digitizes a “portion of a frequency spectrum

of the input signal.” Thus, it is my opinion that Pugel teaches features of claims 40, 54, 68, and 82.

9.2. Ground B: Pugel in view of Crols

9.2.1. Claims 27-28, 33, 37, 39-42, 47, 51, 53-56, 61, 65, 67-70, 75, 79, and 81-82

155. As I explained in Section 9.1, Pugel teaches the limitations of claims 27-28, 33, 37, 39-42, 47, 51, 53-56, 61, 65, 67-70, 75, 79, and 81-82.

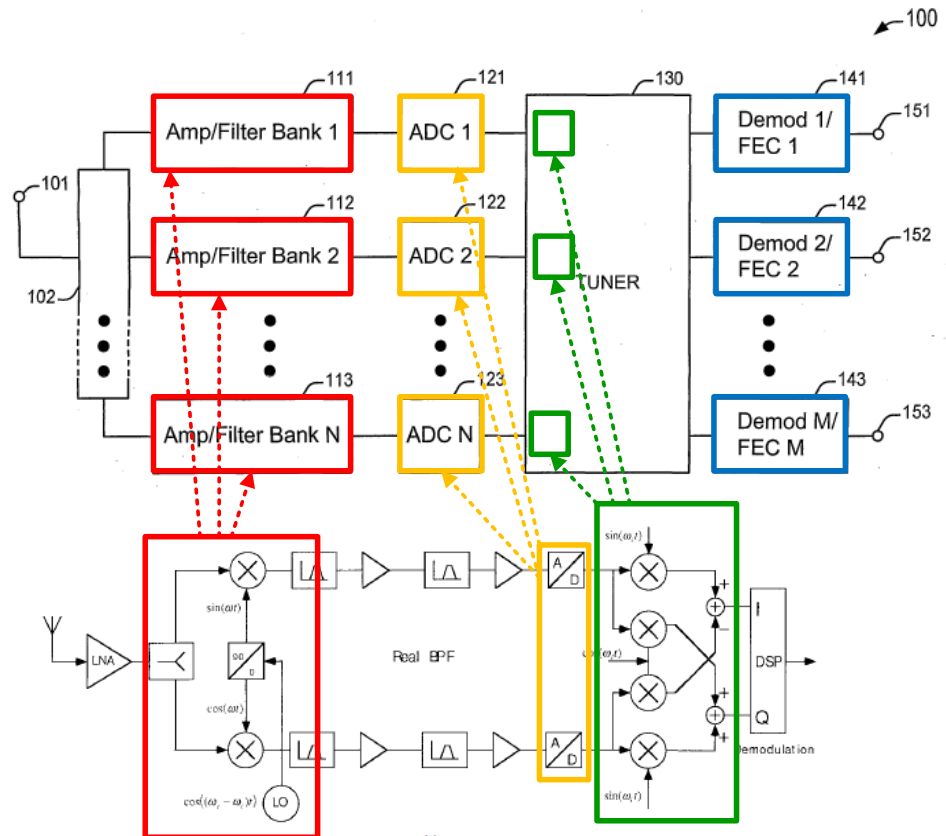
156. It is my opinion that to any extent that a means-plus-function construction of “digital down converter” applies, and Pugel’s tuner 130 is not structurally equivalent to, or perform the same function as, structures (e.g., complex mixers 250 and filter modules 260) described by the ’866 patent for performing the function recited in limitations [27C], [41C], [55C], or [69C], this would be obvious in view of Crols. Ex. 1201, 6:16-7:19; *see also* Sections 6.1, 6.3, *supra*. As I explained in Section 9.1.1.c for limitation [27C] and Section 9.1.2 for limitation [41C], Pugel teaches a DFE or digital down converter comprising a digital tuner 130. Pugel also teaches that the DFE or digital down converter comprises one or more demodulators, such as the demodulators 141, 142, 143. *See also* Section 9.1.6. The digital tuner 130 or demodulators may comprise “circuitry for providing additional functions, for example adaptive filters for removing multi-path propagation effects.”

Ex. 1224, [0041]. Pugel teaches that the additional functions include “coding, decoding, scrambling, descrambling, rotating, and/or derotating operations prior to passing the digital channel signals to demodulation circuits.” Ex. 1224, [0039]. It is my opinion that a POSITA would have understood this to include downconversion, or have found it obvious, because the claims of Pugel provide an express teaching that the digital tuner 130 may itself perform downconverting of digital signals. Ex. 1224, claims 14-15, 18, 20-21. A POSITA would have been well aware that digitally implemented low pass filters were used in RF receivers to select signals of desired television channels in RF receivers. *See* Section 8.3.2, *supra*. Signals for a desired television channel are 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. *Id.*

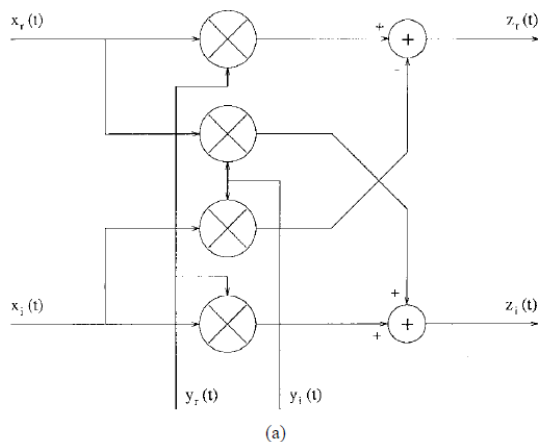
157. In is my opinion that to any extent that Pugel does not teach or suggest implementation details regarding using a complex mixer to perform downconverting at the digital tuner, this would have been obvious to a POSITA in view of Crols because Crols discloses a complex mixer for processing digital signals output by the ADC. The figures of Pugel and Crols relate as follows, with the corresponding mixer in green:

Ex. 1224, Fig. 1
(annotated)

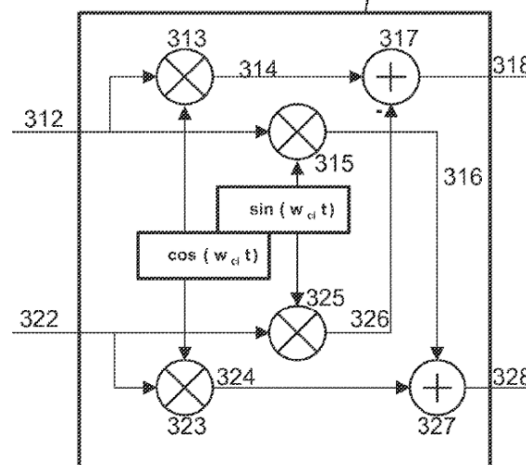
Ex. 1225, Fig. 22
(annotated)



As Crols explains and illustrates, the circuitry outlined in green is a “complex mixer” that is utilized to perform downconversion. Ex. 1225, pp. 273-274, 279-280, Figs. 8(a), 21-22; Ex. 1234, 46-47, Fig. 3.3. Crols’ complex mixer has the identical structure and performs the identical downconversion (i.e., shifting the frequency of in-phase and quadrature components of the digital complex input signal) as mixer 300 shown in Figure 3 of the ’866 patent. Ex. 1225, pp. 273-274, 279-280, Figs. 8(a), 21-22; Ex. 1201, 6:28-48, 9:42-47, Fig. 3; Ex. 1234, p. 63.



Ex. 1225, Fig. 8(a)



Ex 1201, Fig. 3 (excerpted)

158. Therefore, it is my opinion that it would have been obvious to a POSITA that Pugel's digital tuner 130 would incorporate a complex mixer for downconversion as taught by Crols because of Pugel's express teachings that its digital tuner 130 employs downconversion. Ex. 1224, [0039], claims 14-15, 18, 20-21. A POSITA looking to implement downconversion would have turned to techniques known to the art, such as taught by Crols. Even if not expressly taught, such an implementation would have been obvious to try, as Crols' complex mixer topology is one of a finite number of identified, predictable solutions to implement downconversion in digital circuitry, such as a digital tuner. A POSITA would have had a reasonable expectation of success given the express teachings in Pugel to turn to other systems, Crols' detailed descriptions of the operational effectiveness of its

topologies, and the POSITA's own familiarity with known receiver circuit topologies in the art.

9.2.2. Dependent claims 29, 43, 57, and 71

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

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

159. It is my opinion that Pugel discloses the features of claims 29, 43, 57, and 71.

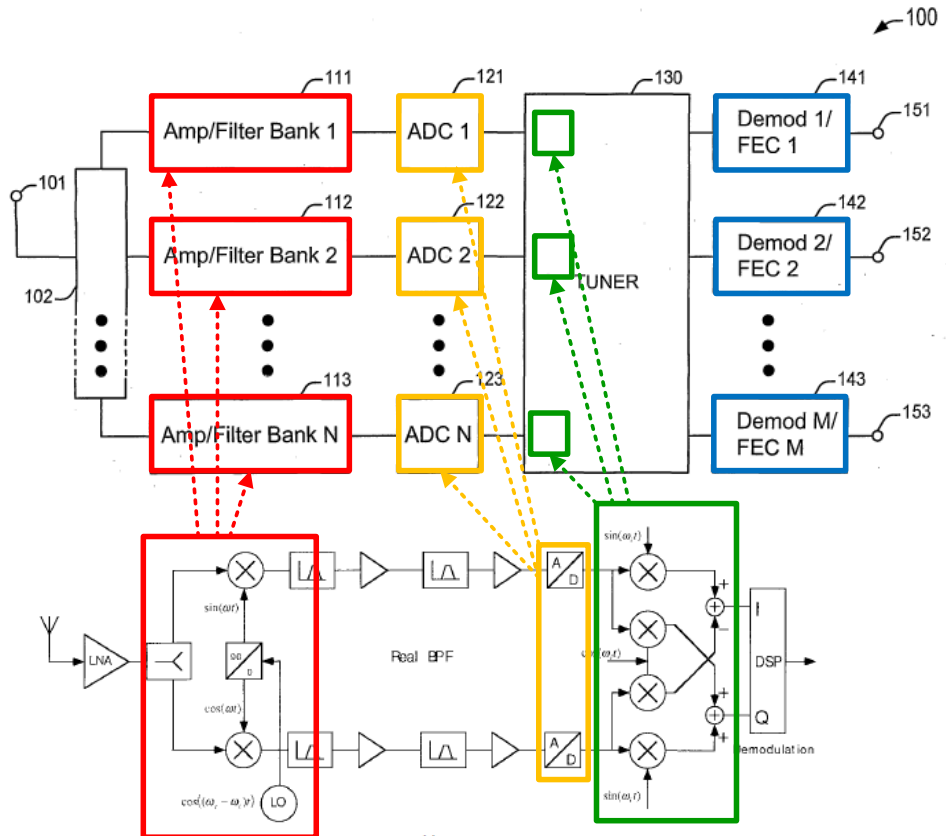
160. As I explained in Section 9.1.1.c for limitation [27C] and Section 9.1.2 for limitation [41C], Pugel teaches a DFE or digital down converter comprising a digital tuner 130. Pugel also teaches that the DFE or digital down converter comprises one or more demodulators, such as demodulators 141, 142, 143. Ex. 1224, [0023]; *see also* Section 9.1.6. Those digital tuner 130 or demodulators may comprise “circuitry for providing additional functions, for example adaptive filters for removing multi-path propagation effects.” Ex. 1224, [0041]. Pugel teaches that the additional functions include “coding, decoding, scrambling, descrambling, rotating, and/or derotating operations prior to passing the digital channel signals to

demodulation circuits.” Ex. 1224, [0039]. A POSITA would have understood this to include downconversion, or have found it obvious, because the claims of Pugel provide an express teaching that the digital tuner 130 may itself perform downconverting of digital signals. Ex. 1224, claims 14-15, 18, 20-21. A POSITA would have been well aware that digitally implemented low pass filters were used to select signals of desired television channels in RF receivers. *See* Section 8.3.2, *supra*. Signals for a desired television channel are 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. *Id.*

161. To any extent that Pugel does not teach or suggest implementation details regarding using a complex mixer to perform downconverting at the digital tuner, this would have been obvious to a POSITA in view of Crols. Crols discloses a complex mixer for processing digital signals output by the ADC. The figures of Pugel and Crols relate as follows, with the corresponding mixer in **green**:

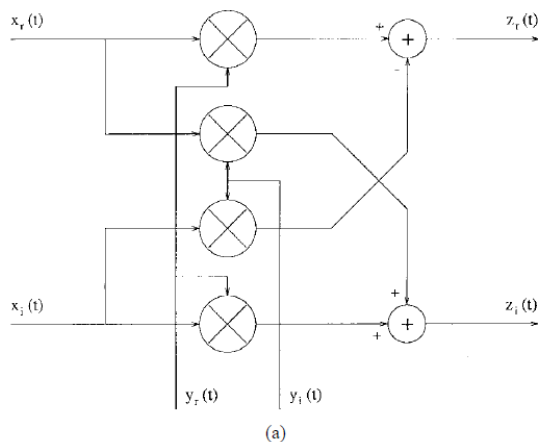
Ex. 1224, FIG. 1
(annotated)

Ex. 1225, FIG. 22
(annotated)

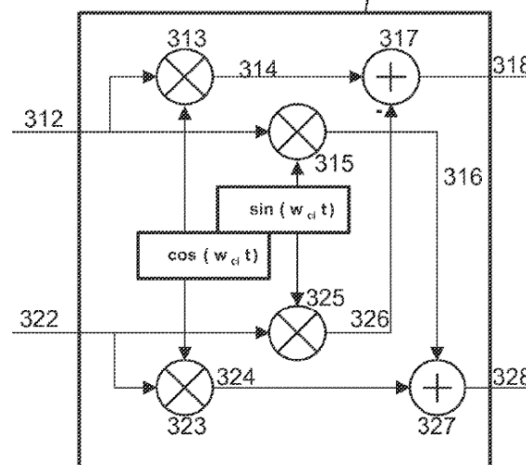


As Crols explains and illustrates, the circuitry outlined in green is a “complex mixer” that is utilized to perform downconversion. Ex. 1225 at 273-274, 279-281, Figs. 8(a), 21-22; *see also* Ex. 1234 at 46-47, Fig. 3.3. Both sine and cosine signals are used to downconvert each of the in-phase and quadrature components such that unwanted mirror signals are not present in the downconverted signals. Ex. 1225 at 273-274.

162. Crols’s complex mixer has the identical structure and performs the identical downconversion (i.e., shifting the frequency of in-phase and quadrature components of the digital complex input signal) as mixer 300 shown in Figure 3 of the ’866 Patent. Ex. 1225 at 273-274, 279-280, Figs. 8(a), 21-22; Ex. 1201, Fig. 3, 6:28-47, 9:42-47; *see also* Ex. 1234 at 63-.



Ex. 1225, Fig. 8(a)

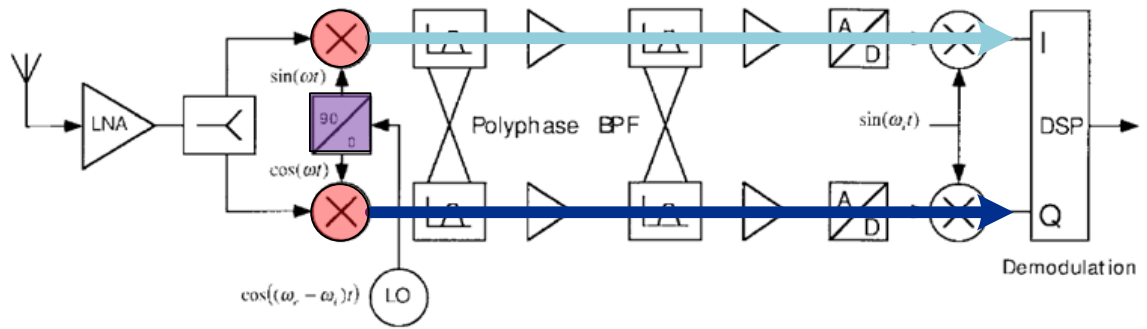


Ex 1201, Fig. 3 (excerpted)

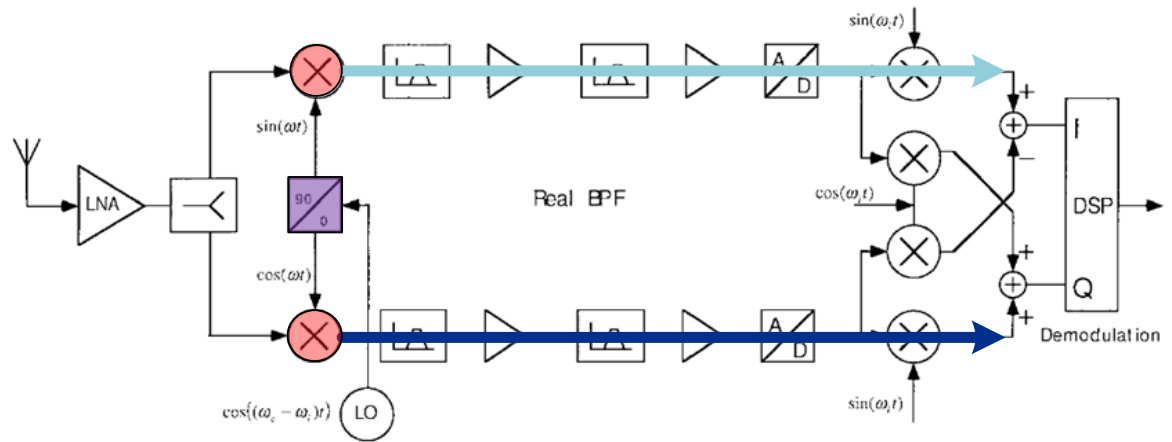
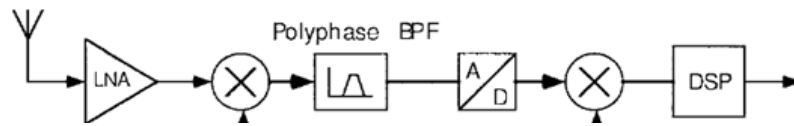
163. It is my opinion that it would have been obvious to a POSITA that Pugel's digital tuner 130 would incorporate a complex mixer for downconversion as taught by Crols because of Pugel's express teachings that its digital tuner 130 employs downconversion and the POSITA's awareness that the digital signals needed to be shifted to baseband to use low pass filters for channel selection. Ex. 1224, [0039], claims 14-15, 18, 20-21; see Section 8.3.2, *supra*. Furthermore, a POSITA looking to implement downconversion would have turned to techniques known to the art, such as taught by Crols. Even if not expressly taught, such an implementation would have been obvious to try, as Crols's complex mixer topology is one of a finite number of identified, predictable solutions to implement downconversion in digital circuitry, such as a digital tuner and Pugel's express teaching that Pugel's "digital tuner 130 may include a multitude of components

configured as is well known in the art to recover a plurality of digital channel signals substantially simultaneously.” Ex. 1224, [0037]. A POSITA would have had a reasonable expectation of success given the express teachings in Pugel to turn to other systems, Crols’s detailed descriptions of the operational effectiveness of its topologies, and the POSITA’s own familiarity with known receiver circuit topologies in the art.

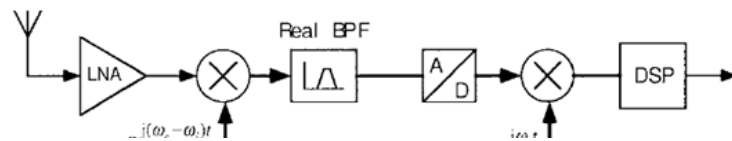
164. Further, the mixers of Crols produce in-phase and quadrature signals. Crols teaches the creation of an in-phase signal (**dark blue line**) and a quadrature signal (**light blue line**). Ex. 1225 at 277, 279, 281-282; *see* Ex. 1234 at 42-43, 65-67. Crols teaches using two mixers (**red**) to create an in-phase signal (the output of the lower mixer with “ $\cos(\omega t)$ ” input in Figures 21(a) and 22(a), **dark blue**) and a quadrature signal (the output of the upper mixer with “ $\sin(\omega t)$ ” input in Figures 21(a) and 22(a), **light blue**) by respectively using a sine signal and a cosine signal generated by a quadrature oscillator (**purple**). Ex. 1225 at 277 (“Quadrature oscillators often use an *RC-CR* circuit to obtain the 90° phase shift. The phase shift is a result of comparing the phase shift of a pole and a zero.”), 279-282; Ex. 1234 at 42-43, 65-67; *See* Section 8.3.1, *supra*.



(a)



(a)



Ex. 1225, Figs. 21(a), 22(a) (annotated)

165. It is my opinion that it would have been obvious to a POSITA to modify Pugel's receiver circuit to implement Crol's mixers (as illustrated above) because, in doing so, a POSITA would have understood that Pugel teaches the use of QAM

or QPSK demodulation, which are required for cable television channels, and that in-phase and quadrature signals are used in those modulation schemes. Ex. 1224, [0040]; *See* Sections 8.2.2-3, *supra*. Thus, applying Crols topologies comprising mixer modules to Pugel's receiver circuits would have been nothing more than applying a known technique (generating in-phase and quadrature signals) to improve a known device (Pugel's receiver which performs QAM or QPSK demodulation) ready for improvement to yield predictable results (the resulting implementation of Pugel-Crols would be capable of performing QAM or QPSK modulation as taught by Pugel).

166. Thus, it is my opinion that Pugel in view of Crols discloses the features of claims 29, 43, 57, and 71.

9.2.3. Dependent claims 30, 44, 58, 72

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

167. It is my opinion that Pugel in view of Crols discloses the features of claims 30, 44, 58, and 72.

168. The Pugel multichannel receiver circuit comprises a "plurality of amplifier-filter banks or circuits 111, 112, 113 [red] ... configured to process frequencies within a specified band." Ex. 1224, [0028], Figs. 1-2. Pugel contemplates that the amplifier-filter banks may act as bandpass filters that will

process bands of limited frequency ranges for input to different analog-to-digital converters (ADCs). Ex. 1224, [0025]-[0032], Figs. 1-2. For example, Pugel describes splitting the multichannel analog RF input signal, ranging from about 5 MHz to about 900 MHz and comprising both desired and undesired television channels, into three analog bands by using the amplifier-filter circuits 111, 112, 113; the amplifier-filter circuit 111 processes the first analog band ranging from 5 to 300 MHz, the amplifier-filter circuit 112 processes the second analog band ranging from 300 to 600 MHz, and the amplifier-filter circuit 113 processes the third analog band ranging from 600 to 900 MHz. Ex. 1224, [0024]-[0026], [0028], [0034].

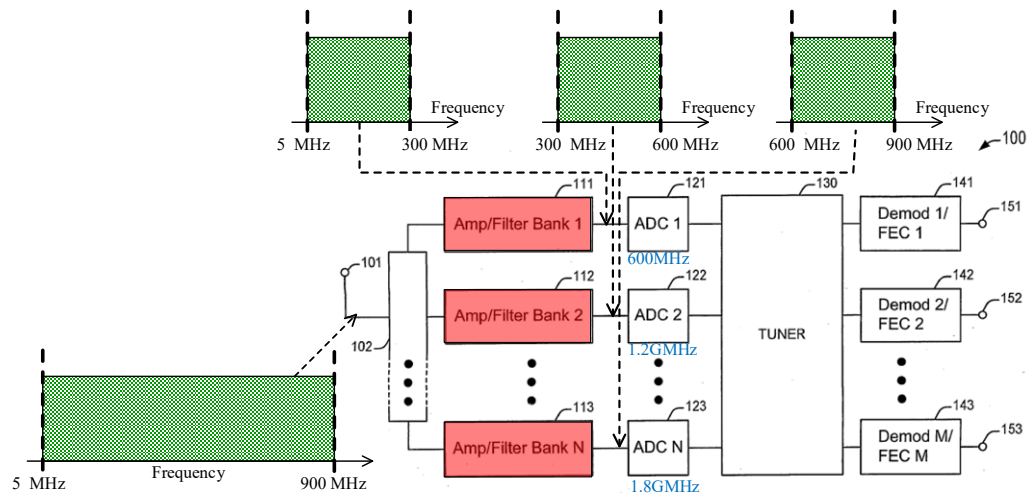


FIG. 1

Ex. 1224, Fig. 1 (annotated, example without Pugel's undersampling)

169. The analog signals in the analog bands processed by the amplifier-filter circuits 111, 112, 113 are converted to digital signals by the ADCs 121, 122, 123. Ex. 1224, [0024]. It is well known that ADCs convert incoming analog RF signals

to digital signals by sampling the analog RF signals at a rate that is at least twice the highest frequency contained in the analog signals. *See* Section 8.3.4, *supra* (citing Ex. 1245 at 70; Ex. 1233 at 98-101). Therefore, the first band of 5 MHz to 300 MHz needs to be sampled with a sampling rate of 600 MHz, the second band of 300 MHz to 600 MHz needs to be sampled with a sampling rate of 1.2 GHz, and the third band of 600 MHz to 900 MHz needs to be sampled with a sampling rate of 1.8 GHz. Ex. 1224, [0033]-[0034]. Pugel recognizes the problem that three different clock devices are required to produce the different sampling rates and that some of the sampling rates are quite high (e.g., 1.8 GHz for the third analog band). Ex. 1224, [0033]-[0034].

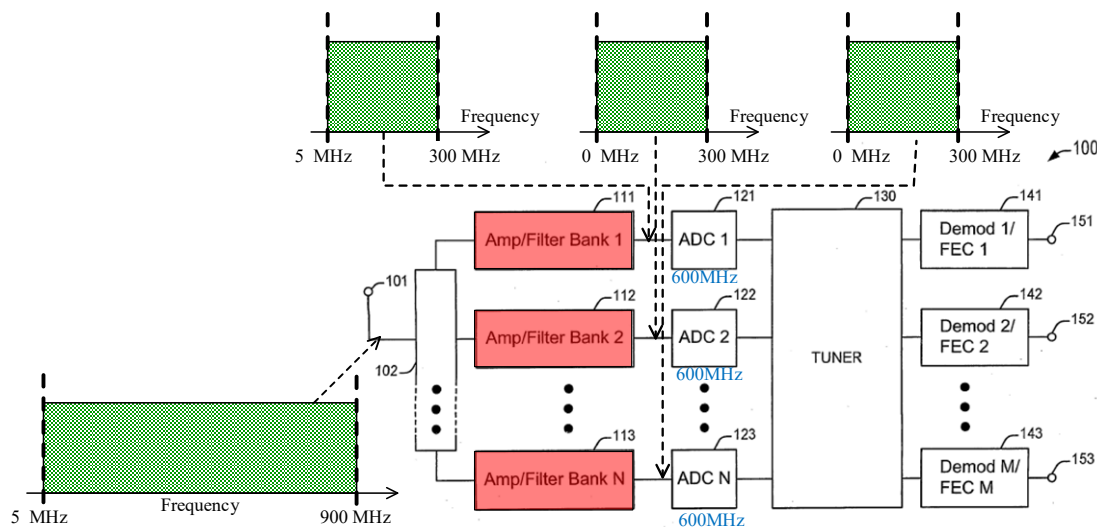


FIG. 1

Ex. 1224, Fig. 1 (annotated, example with Pugel's undersampling)

170. To resolve the problem, Pugel teaches that undersampling can be performed to shift the analog bands in the frequency spectrum such that each analog

band has, for example, a highest band frequency of 300 MHz and that the Nyquist criterion can be met by the analog-to-digital converters 121, 122, 123 with the same sampling frequency of 600 MHz. Ex. 1224, [0032]-[0034]. Furthermore, Pugel describes that a single clock device can provide the requisite clock signal for all of the analog-to-digital converters 121, 122, 123. *Id.*

171. It is my opinion that when Pugel states that the third analog band of 600 MHz to 900 MHz can be sampled at 600 MHz while satisfying the Nyquist criterion, it means that Pugel's undersampling technique incorporates downconverting of the third analog band to baseband (e.g., to the frequency range of 0 MHz to 300 MHz). *Id.* Similarly, the second analog band of 300 to 600 MHz is downconverted to baseband (e.g., to 0 to 300 MHz, so that the second analog band can also be sampled at 600 MHz).

172. It is my opinion that the teaching in Pugel is also consistent with Crols's express teachings, which state that "[i]t will be presumed that the demodulation is preferably done with a DSP at baseband." Ex. 1225 at 269; *see also* Section 8.3.1, *supra*. For example, concerning Crols's Figures 21-22, Crols teaches that "[t]he final downconversion of the wanted signal to the baseband can then be done by multiplication with a sine." Ex. 1225 at 279.

173. To any extent that Pugel-Crols does not explicitly disclose the I and Q components of each complex signal at baseband, this would have been obvious. A

POSITA would have understood that when Pugel states that undersampling is performed such that a frequency band of 600 MHz to 900 MHz can be sampled at 600 MHz while satisfying the Nyquist criterion, Pugel's undersampling thus incorporates downconverting to baseband, as the signal must be downconverted from 600-900 MHz to 0-300 MHz in order for 600 MHz sampling to satisfy the Nyquist criterion, which is based on sampling at double the highest frequency in the pass-band. *See* Ex. 1224, [0033]-[0034], claims 14-15, 18, 20-21. To any extent not explicitly disclosed, it is my opinion that the use of downconverting to achieve this goal would be obvious or inherent to a POSITA because of the disclosures in Pugel-Crols, including recitations of downconversion in the claims. Ex. 1224, claims 14-15, 18, 20-21; Ex. 1225 at 269, 279-280. It would have been obvious from Pugel's and Crols's express teachings (that a Nyquist criterion is met by a frequency lower than the maximum frequency in a band, and that signals should be at baseband for demodulation) to use well-known techniques of downconversion to baseband to implement the system of Pugel-Crols. At most, this would have been nothing more than applying a known technique (downconversion to baseband as taught by Pugel and Crols) to a known device (Pugel's multichannel receiver circuit) ready for improvement to yield predictable results (the Nyquist criterion is met as taught by Pugel). Further, a POSITA would have understood the use of downconversion is inherent to the disclosure, as the Nyquist criterion cannot be mathematically satisfied

as per Pugel's examples unless the maximum frequency of the pass-band is also reduced. A POSITA would have had a reasonable expectation of success, as Pugel itself says the result is possible, and downconversion was well-known in the art.

174. Thus, it is my opinion that Pugel in view of Crols discloses the features of claims 30, 44, 58, and 72.

9.2.4. Dependent claims 32, 46, 60, 74

[32/60] "The cable TV device of claim [29/57], wherein:

the DFE comprises a plurality of digital demodulators, and each digital demodulator, of the plurality of digital demodulators, is operable to demodulate the corresponding complex signal."

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

175. It is my opinion that Pugel in view of Crols discloses the features of claims 32, 46, 60, and 74.

176. Pugel teaches demodulators for demodulating a plurality of desired channels, as discussed above in Section 9.1.6 regarding claims 33, 47, 61, and 75. Further, Pugel-Crols teaches generating a complex signal comprising an in-phase and a quadrature component, as discussed in Section 9.2.2 regarding claims 29, 43, 57, and 71. The resulting modification of Pugel-Crols thus creates a complex signal that is then demodulated by the demodulators. A POSITA would have understood that Pugel's demodulators would have been designed for such signals, as, for

example, Pugel discloses that the demodulators may perform QAM demodulation of digital cable television signals, and QAM demodulation utilizes complex signals comprising in-phase and quadrature components. Ex. 1224, [0040]. To any extent this is not explicitly disclosed, it is my opinion that it would have been obvious for Pugel's demodulators to receive a complex signal to enable the performance of QAM demodulation based on Pugel's express teachings. Applying Crols topologies comprising complex signals to Pugel's receiver circuits would have been nothing more than applying a known technique (generating in-phase and quadrature signals) to improve a known device (Pugel's receiver which performs QAM or QPSK demodulation) ready for improvement to yield predictable results (the resulting implementation of Pugel-Crols would be capable of performing QAM or QPSK modulation as taught by Pugel).

9.3. Ground C: Pugel in view of Zaltsman

9.3.1. Dependent Claims 38, 52, 66, 80

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

177. It is my opinion that Pugel in view of Zaltsman discloses the features of claims 38, 52, 66, and 80.

178. Pugel teaches transmission of digital cable television signals using well-known methods, including sending using QAM, QPSK, VSB, and/or HDTV

signals. Ex. 1224, [0040]. It was well-known at the time of the alleged invention that DOCSIS was the predominant standard for sending digital cable transmissions, and it would have been obvious to any POSITA to have turned to the standard to deliver cable television channels as taught by Pugel. *See* Section 8.1, *supra*; *see* Ex. 1221.

179. To any extent that Pugel does not explicitly teach the DOCSIS protocol, the use of the protocol would have been obvious in view of Zaltsman because it would support transmission in consumer networks using the most common standard of the day. Zaltsman provides a detailed background section discussing known technology as of 2007, particularly regarding the use of digital television standards, including DOCSIS in wideband television transmission to a set-top box. Ex. 1274, [0003]-[0023]. In particular, Zaltsman states that, in the latest DOCSIS standard of the day, multiple television channels were bonded together, typically using a 6 MHz frequency band. Ex. 1274, [0012]-[0013]. Modifying Pugel to use the DOCSIS standard as taught by Zaltsman would have been nothing more than applying a known technique (DOCSIS standardized transmission) to a known device (Pugel's receiver circuit for digital cable television transmission) ready for improvement to yield a predictable result (signals from Pugel's receiver circuit are transmitted according to the known DOCSIS standard). A POSITA would have had a reasonable expectation of success, as the standard was well-documented and implementation was well within the skill of the art. *See* Ex. 1221.

9.4. Ground D: Pugel in view of Crols and Zaltsman and further in view of Jensen '170

9.4.1. Dependent Claims 31, 45, 59, 73

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

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

180. It is my opinion that Pugel in view of Crols and further in view of Zaltsman discloses the features of claims 31, 45, 59, and 73.

181. As discussed above in Section 9.1.1, Pugel’s digital tuner 130 receives, via a channel selector 315 coupled to the digital tuner 130, selections of one or more television channels desired by users. Ex. 1224, [0038]. Pugel’s digital tuner 130 is configured to select the signals of the desired television channels from “digital signals converted by the plurality of analog-to-digital converters 121, 122, 123” and output the selected digital channels to demodulation circuits 141, 142, 143. Ex. 1224, [0037]-[0039]. The digital signals from Pugel’s analog-to-digital converters 121, 122, 123 include signals of both desired and undesired television channels. *See* Section 9.1.1, *supra*. Pugel’s digital tuner 130 only outputs the signals of the desired television channels to the demodulation circuits 141, 142, 143. Ex. 1224, [0038]-

[0039]. Pugel further elaborates that the digital tuner 130 can be implemented with one or more digital signal processors. Ex. 1224, [0037].

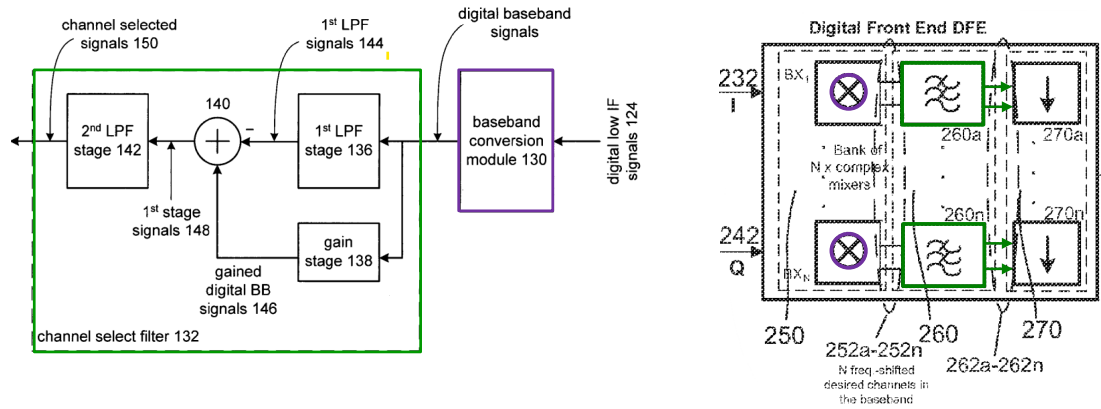
182. Before selecting the signals of the desired television channels from the digital signals produced by the analog-to-digital converters 121, 122, 123, Pugel's digital tuner 130 downconverts the digital signals. Ex. 1224, [0037], claims 14 (reciting "digital processor (130) ... downconverts said multiplexed signal and extracts desired information to be coupled to said first and second demodulator circuits"), 15 (reciting "digital processor (130) downconverts and extracts desired information to be coupled to said first and second demodulator circuits (141, 142)"), 18 (reciting "downconverting said first digital signal and said second signal; and ... extracting desired television program information from said downconverted first digital signal and said second digital signal"), 20-21; *See* Section 9.1.2, *supra*.

183. Pugel does not expressly disclose in detail the components inside the digital tuner 130 that perform the downconversion process followed by the selection process. However, Pugel suggests that the digital tuner may include "a multitude of components configured as is well known in the art to recover a plurality of digital channel signals substantially simultaneously." Ex. 1224, [0037].

184. To any extent that Pugel does not explicitly disclose the components of the digital tuner 130 configured to perform the downconversion and the selection, it is my opinion that Jensen '170 discloses components that can be implemented in

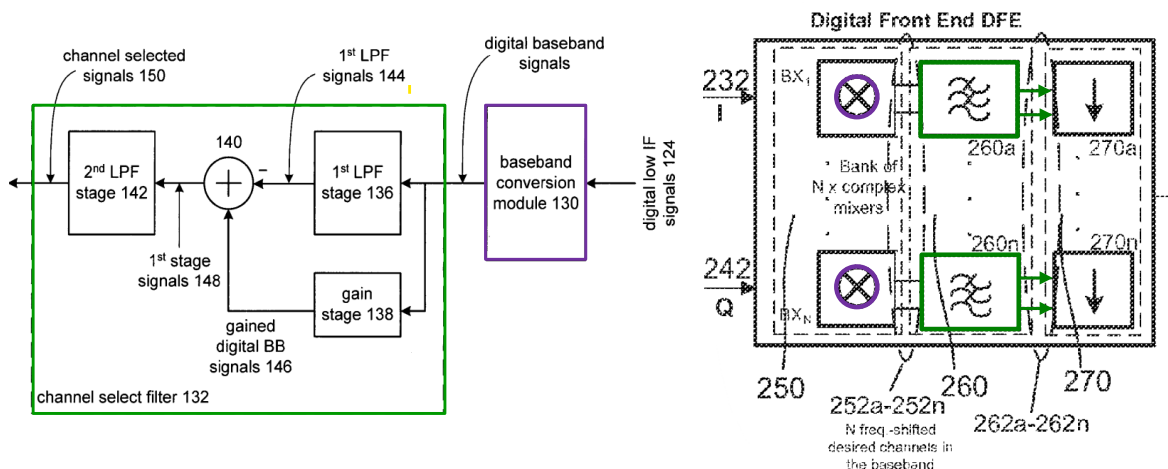
digital signal processors of RF receivers, where the digital signal processors perform the downconversion process followed by the selection process of desired channels. Ex. 1230, [0007], [0009], [0016]-[0017], [0064]-[0067]. For example, Jensen '170 describes using a baseband conversion module 130 to downconvert digital signals. Ex. 1230, [0017], [0064]-[0065]. It is my opinion that the operation of Jensen '170's baseband conversion module 130 is similar to the frequency-shifting operation of the complex mixers 250 of the '866 patent as both components downconvert digital signals to baseband frequency. *Compare* Ex. 1230, [0017], [0064]-[0065] *with* Ex. 1201, Fig. 2 (mixers 250), 6:3-6, 6:53-63.

185. A "channel select" filter 132 follows the baseband conversion module 130 in Jensen '170, where low pass filters (LPFs) are used to build the channel select filter 132. Ex. 1230, Fig. 9 (channel select filter 132), [0009], [0016]-[0017], [0064], [0066]-[0067]. It is my opinion that Jensen '170's channel select filter 132 is like the filters 260 in the '866 patent as they both perform the claimed selection by allowing only selected signals to pass through the filters and blocking the undesired signals. *Compare* Ex. 1230, Fig. 9 (channel select filter 132), [0009], [0016]-[0017], [0064], [0066]-[0067] *with* Ex. 1201, Fig. 2 (filters 260), 6:3-12, 6:64-7:9.



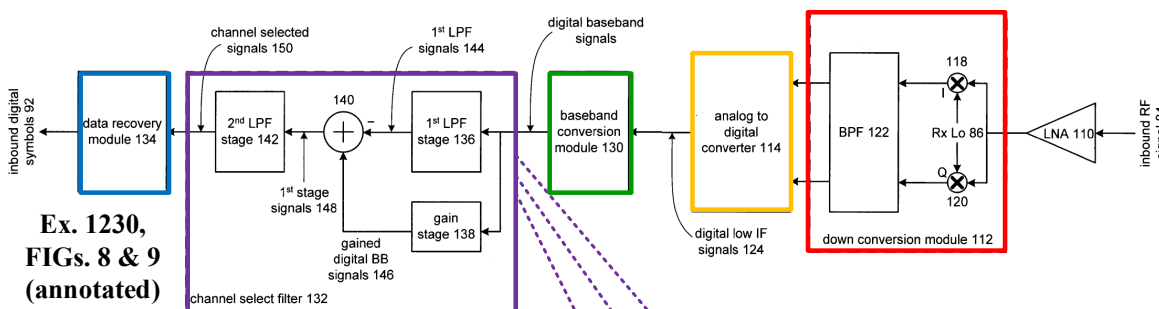
Ex. 1230, Fig. 9 (annotated, excerpted); Ex. 1201, Fig. 2 (annotated, excerpted)

186. Specifically, it is my opinion that a portion of Jensen '170's digital demodulator 116 (above left), including the baseband conversion module 130 (purple) followed by the channel select filter 132 (green), is the same as each of the I path 232 and Q path 242 of the '866 patent's digital front end 230 (above right). Compare Ex. 1230, Fig. 9, [0064]-[0066] with Ex. 1201, Fig. 2, 6:3-12. The channel select filter 132 in Jensen '170 includes a first low pass filter stage 136 and a second low pass filter stage 142, and the low-pass filters are implemented with finite impulse response (FIR) filters. Ex. 1230, [0010], [0064]-[0067], [0071]-[0073].

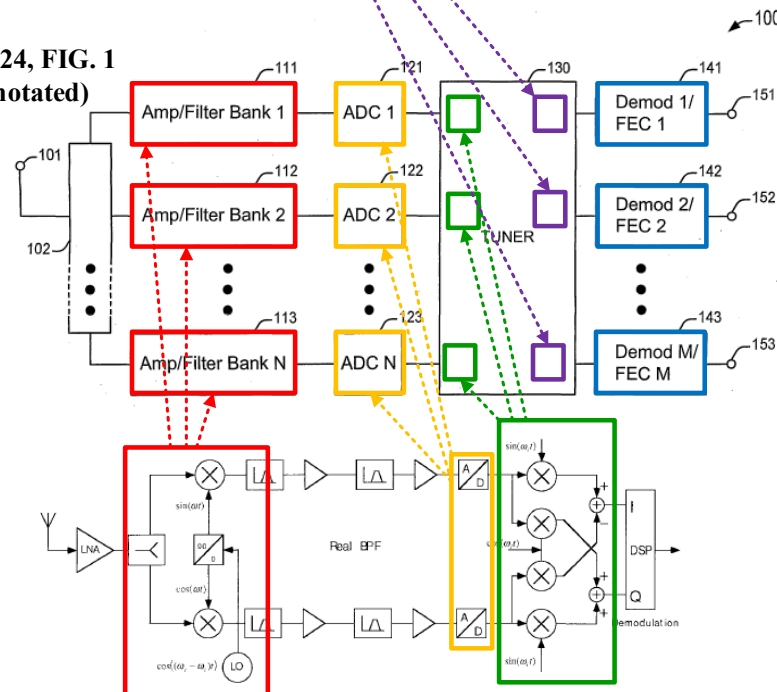


Ex. 1230, Fig. 9 (annotated, excerpted); Ex. 1201, Fig. 2 (annotated, excerpted)

187. Digital low IF signals enter the baseband conversion module 130 in Jensen '170, where the baseband conversion module 130 shifts the frequency of the desired channel to baseband. Ex. 1230, [0064]-[0065]. The channel select filter 132 then selects the desired channels, while filtering out the remaining channels. Ex. 1230, [0007], [0009]-[0010], [0012], [0067]-[0068]. Pugel in view of Crols and further in view of Jensen '170 thus teach claims 31, 45, 59, and 73.



Ex. 1224, FIG. 1 (annotated)



188. Following Jensen '170, it is my opinion that a POSITA would have included circuit topologies of the channel select filter 132 as taught by Jensen '170 in the digital tuner 130 of Pugel/Crols's receiver (as illustrated above) because a POSITA would have been motivated to implement Pugel's digital tuner 130 with known solutions, in view of Pugel's express teaching that digital tuner 130 could be implemented with "a multitude of components configured as is well known in the art to recover a plurality of digital channel signals." Ex. 1224, [0037].

189. It is my opinion that applying Jensen '170 channel select filter 132 comprising FIR-based low pass filters to Pugel's digital tuner 130 would have been nothing more than applying a known technique (using channel select filters to filter signals of desired channels as taught by Jensen '170) to improve a known device (Pugel's digital tuner 130) to yield predictable results (Pugel's digital tuner 130 filtering signals of desired television channels using Jensen '170's channel select filters). A POSITA would have had a reasonable expectation of success given the express teachings in Pugel to turn to other systems, such as Jensen '170's detailed descriptions of using channel select filters implemented using FIR architecture, and the POSITA's own familiarity with known receiver circuit topologies in the art.

190. And, as further described in Section 9.3, it would have been obvious to modify Pugel in view of Zaltsman to use the DOCSIS standard, which employs 6 MHz channels. *See* Section 8.1, *supra* (citing Ex. 1221 at 2-5, Fig. 1-2; Ex. 1233 at 27, 211-212). Modifying Pugel in view of Crols and Jensen '170 would have been obvious for the same rationale, and the additional references would have presented no additional difficulties for the combination to a POSITA.

9.5. Ground E: Pugel in view of Chandrakasan

9.5.1. Independent Claim 1

191. The elements of claim 1 appear in the Claims Listing Appendix, labeled as Elements [1A]-[1C]. For the following reasons, it is my opinion that Elements [1A]-[1C] are rendered obvious by Pugel in view of Chandrakasan.

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

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

192. Elements [1A]-[1B] recites similar features as Elements [27A]-[27B]. Thus, it is my opinion that Elements [1A]-[1B] are thus disclosed and taught as obvious by Pugel for the same reasons discussed above with respect to Elements [27A]-[27B]. *See* Sections 9.1.1.a-b, *supra*.

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

193. Element [1C] is identical to Element [27C], except Element [1C] recites “provide ... via a serial interface.” Save the feature of “provide ... via a serial interface,” it is my opinion that the other features of [1C] are thus disclosed and taught as obvious by Pugel for the same reasons discussed above with respect to

Element [27C]. *See* Section 9.1.1.c, *supra*. As explained above in Sections 9.1.1.c and 9.1.2, Pugel teaches a digital tuner 130 as a DFE or digital down converter. But Pugel is silent with regard to whether its selected channels may be output via a serial interface or via a parallel interface.

194. However, as the '866 patent concedes, outputting a digital datastream via serial and parallel interfaces were “commonly known methods,” which I have been informed is Applicant Admitted Prior Art (AAPA). Ex. 1201, 7:10-14; *see* Section 8.4, *supra*. Indeed, as explained in dictionaries, basic textbooks and technical papers on digital integrated circuit design at the time, a POSITA would have understood that using these two interfaces were two common options for outputting data in standard integrated circuits. Ex. 1214, 30:31-42, 31:15-22; Ex. 1215 at 5-6, 8; Ex. 1216 at 79-80; Ex. 1217 at 354-355.

195. For example, the 7th edition of the Authoritative Dictionary of IEEE Standard Terms (“IEEE”) teaches both “serial interface” and “parallel interface.” IEEE defines “serial” as “[o]ne bit following another over a single pathway” and “serial interface” as “[a]n interface that transmits data bit by bit rather than in whole bytes.” Ex. 1215 at 8. IEEE defines “bit parallel” as “[p]ertaining to a method for simultaneously processing all bits as a contiguous set of bits over separate wires, one wire for each bit.” Ex. 1215 at 5.

196. Basic textbooks also teach “serial interface” and “parallel interface.” For example, as explained in the textbook “Digital Integrated Circuits: A Design Perspective” published in 2002 (“Rabaey”), a digital integrated circuit represents 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. 1216 at 31-34, *see also* 23, 28-29, 49-51, 79-80 (Figure 6.25).

197. 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 is 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. 1216 at 79-80 (Figure 6.25).

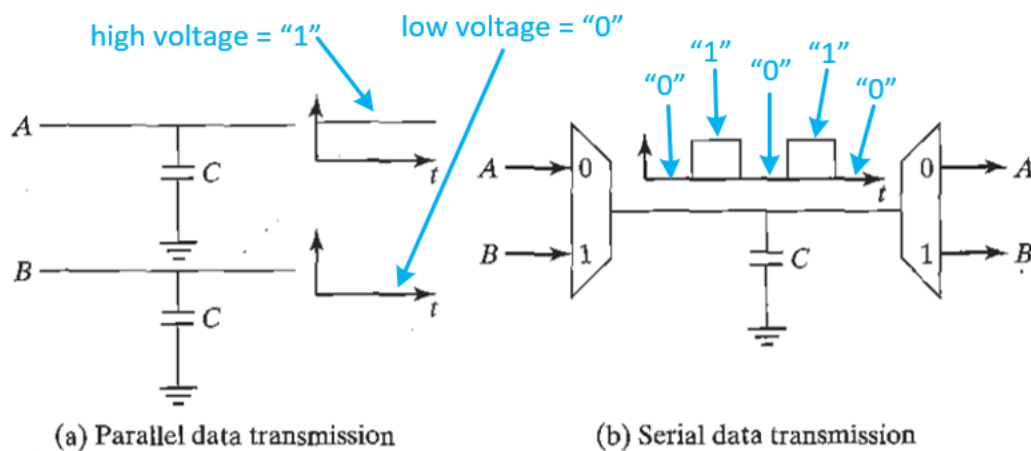


Figure 6-25 Parallel versus time-multiplexed data busses.

Ex. 1216 at 80 (Figure 6.25) (annotated)

198. At the most fundamental level, a digital integrated circuit represents 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. 1216 at 31-34; *see also* 17, 27-28, 49-51. Pugel teaches that its ADCs output digital signals at varying resolutions with differing numbers of bits. Ex. 1224, [0036]. To output multiple bits (i.e., as a “digital datastream”), the digital tuner 130 can either transmit the bits over multiple separate wires, one wire for each bit, which is 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 is known as a “serial interface.” Ex. 1215 at 5-6, 8; Ex. 1216 at 79-80 (Figure 6.25).

199. Implementing Pugel’s data interface to a demodulator using either option would have been obvious as design choices, because both were “commonly known methods,” as Applicant admits and as shown in the background art that demonstrates such interfaces were known and used by POSITAs in integrated circuit designs at the time. Ex. 1214, 30:31-42, 31:15-22; Ex. 1215 at 5-6, 8; Ex. 1216 at 79-80; Ex. 1217 at 354-355; Ex. 1248 at 16. For the same reasons, it is my opinion that implementing serial and parallel interfaces would have been well within the POSITA’s skillset, and thus, a POSITA would have had a high expectation of success, leading to a predictable result.

200. As another example, Chandrakasan, an article on “Ultra Low Power Digital Signal Processing,” teaches that both serial (referred to in Chandrakasan as “time-multiplexed”) and parallel interfaces such as those illustrated in Figure 6.25

above were used in integrated circuits. Ex. 1217 at 355; Ex. 1216 at 79-80, Fig. 6.25. Specifically, Chandrakasan teaches that time-multiplexing (i.e., a serial interface) is often used “due to area constraints or if very high-throughput is not the goal,” but that “[g]iven that there is a choice between time-multiplexed and fully-parallel architectures... an important question which arises is what architecture will result in the lowest switching activity.” Ex. 1217 at 355. Minimizing the circuit area minimizes the cost of the integrated circuit, while minimizing the switching activity minimizes the power consumed by the integrated circuit. Ex. 1217 at 355-357. Thus, Chandrakasan teaches selecting between serial and parallel interfaces for transmitting digital data between two points, both of which have advantages over each other, depending upon area and power constraints and the temporal correlation between the signals. *Id.*

201. It is my opinion that it would thus have been obvious to a POSITA to apply either of parallel data or serial data communication as taught by Chandrakasan to the interconnection between Pugel’s digital tuner 130 and demodulators 141-143. Ex. 1224, [0038]-[0041], [0045]-[0046]; Ex. 1217 at 354-356.

202. As such, the modification of Pugel with Chandrakasan that results in a serial interface or parallel interface between Pugel’s digital tuner 130 and demodulators 141-143 is nothing more than choosing from a finite number of identified and predictable solutions (using serial or parallel communications as

taught by Chandrakasan and known in the art) with a reasonable expectation of success (resulting in Pugel's system implemented with either serial or parallel communication). The resultant combinations of Pugel and Chandrakasan are predictable, and it is my opinion that a POSITA would have had a reasonable expectation of success, because Chandrakasan teaches basic techniques used by POSITAs to design integrated circuits, and because those techniques are specifically directed to overcoming specific issues, such as meeting area and power constraints, that are often necessary for a successful design. Ex. 1217 at 355-357.

203. Thus, it is my opinion that the combination of Pugel and Chandrakasan discloses claim 1.

9.5.2. Independent Claim 14

[14A, 14B, 14C] "A cable TV device comprising:

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

a plurality of digital down converters coupled to the wideband ADC, wherein each digital down converter, of the plurality of digital down converters, is operable to generate a digital channel output corresponding to each desired channel, of the plurality of desired channels, and"

204. Elements [14A]-[14C] recite similar features as Elements [41A]-[41C]. Elements [14A]-[14C] are thus disclosed and taught as obvious by Pugel for the

same reasons discussed above with respect to Elements [41A]-[41C], in my opinion.

See Section 9.1.2, *supra*.

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

205. Pugel teaches Element [14D] in view of Chandrakasan for the same reason as “via a serial interface” is taught as to Element [1C]. *See* Section 9.5.1.b, *supra*.

206. Thus, it is my opinion that the combination of Pugel and Chandrakasan discloses claim 14.

9.5.3. Dependent Claims 2 and 15

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

207. It is my opinion that for the same reasons set forth for [28] in Section 9.1.5, Pugel teaches the additional limitations of claims [2] and [15].

9.5.4. Dependent Claims 7 and 20

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

[20] “The cable TV device of claim 14, wherein: each digital down converter comprises a digital demodulator operable to demodulate a

desired channel, of the plurality of desired channels, to provide a demodulated channel as the digital channel output.”

208. It is my opinion that for the same reasons set forth for [33] and [47] in Section 9.1.6, Pugel teaches the additional limitations of claims [7] and [20].

9.5.5. Dependent Claims 8, 21, 34, 48, 62, and 76

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

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

209. It is my opinion that the combination of Pugel and Chandrakasan teaches DFE/the plurality of digital down converters “is operable to provide a plurality of demodulated desired channels via a parallel interface,” as recited in claims 8, 21, 34, 48, 62, and 76.

210. As I explained above, Pugel teaches a digital tuner 130 in communication with one or more demodulators 141-143. *See* Sections 9.1.6, 9.5.1, 9.5.4, *supra*. And as I furthered explained above with respect to Element [1C], Pugel in view of Chandrakasan teaches that it would have been obvious to provide the plurality of channels as an input to demodulators 141-143 via a parallel or serial interface (as illustrated below in annotated Figure 1 of Pugel). *See* Section 9.5.1.b, 8.4, *supra*. For a similar rationale, it is my opinion that it would have been

obvious to a POSITA that the output of the demodulators 141-143 could also be provided via a parallel interface or a serial interface (as illustrated below in annotated Figure 1 of Pugel).

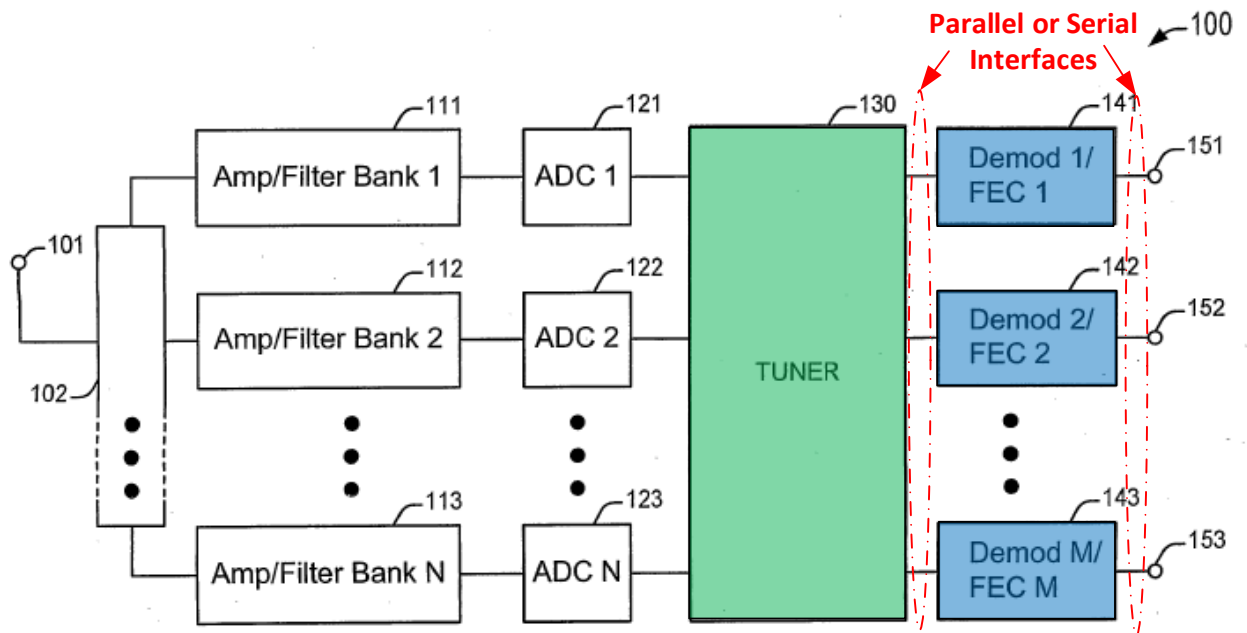


FIG. 1

Ex. 1224, Fig. 1 (annotated)

211. It is my opinion that Pugel's output couplers 151, 152, 153 can output demodulated digital video signals from the demodulators 141, 142, 143 using either option, parallel interface or serial interface, as both would have been obvious as available design choices. Both parallel and serial interfaces were "commonly known methods," as Applicant admits and as shown in the background art that demonstrates such interfaces were known and used by POSITAs in integrated circuit designs at

the time. Ex. 1214, 30:31-42, 31:15-22; Ex. 1215 at 5-6, 8; Ex. 1216 at 79-80; Ex. 1217 at 354-355; *see* Section 8.4, *supra*. For the same reasons, implementing serial and parallel interfaces at Pugel’s output coupler 151, 152, 153 would have been well within the POSITA’s skillset, and thus, a POSITA which would have had a high expectation of success leading to predictable results.

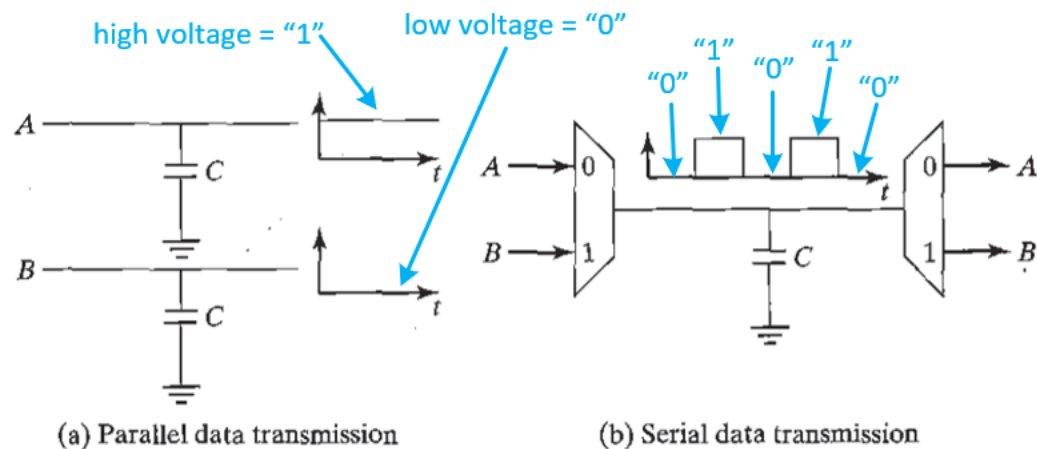


Figure 6-25 Parallel versus time-multiplexed data busses.

Ex. 1216, p. 80 (Figure 6.25) (annotated)

212. Furthermore, Chandrakasan teaches that both serial (referred to in Chandrakasan as “time-multiplexed”) and parallel interfaces, such as those illustrated in Figure 6.25 above were used in integrated circuits. Ex. 1217 at 355; Ex. 1216 at 79-80. Specifically, Chandrakasan teaches that time-multiplexing (i.e., a serial interface) is often used “due to area constraints or if very high-throughput is not the goal,” but that “[g]iven that there is a choice between time-multiplexed and fully-parallel architectures... an important question which arises is what architecture will result in the lowest switching activity.” Ex. 1217 at 355. Minimizing the circuit

area minimizes the cost of the integrated circuit, while minimizing the switching activity minimizes the power consumed by the integrated circuit. Ex. 1217 at 355-357. Thus, Chandrakasan teaches selecting between serial and parallel interfaces for transmitting digital data between two points, both of which have advantages over each other, depending upon area and power constraints and the temporal correlation between the signals. *Id.*

213. It would thus have been obvious to apply either of parallel data or serial data communication as taught by Chandrakasan to the output from Pugel's demodulators 141-143 via the output couplers, 151, 152, 153. Ex. 1224, [0038]-[0041], [0045]-[0046]; Ex. 1217 at 354-356. As such, the modification of Pugel with Chandrakasan that results in a parallel interface as an output from demodulators 141-143 is nothing more than choosing from a finite number of identified, predictable solutions (using serial or parallel communications as taught by Chandrakasan and known in the art) with a reasonable expectation of success (resulting in Pugel's system implemented with either serial or parallel communication). The resultant combinations of Pugel and Chandrakasan are predictable, and a POSITA would have had a reasonable expectation of success, because Chandrakasan teaches basic techniques used by POSITAs to design integrated circuits, and because those techniques are specifically directed to

overcoming specific issues, such as meeting area and power constraints, that are often necessary for a successful design. Ex. 1217 at 355-357

214. Thus, it is my opinion that the combination of Pugel and Chandrakasan teaches claims 8, 21, 34, 48, 62, and 76, for the same reasons discussed above with respect to their base claims 1, 14, 27, 41, 55, and 69, and further based on the additional teachings of Chandrakasan as discussed above.

9.5.6. Dependent Claims 9 and 22

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

215. It is my opinion that for the same reasons set forth in Section 9.1.7, Pugel teaches the additional limitations of claims [9] and [22].

9.5.7. Dependent Claims 11 and 24

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

216. It is my opinion that for the same reasons set forth for [27D] in Section 9.1.1.d, Pugel teaches the additional limitations of claims [11] and [24].

9.5.8. Dependent Claims 12 and 25

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

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

217. It is my opinion that for the same reasons set forth for [55D] in Section 9.1.3, Pugel teaches the additional limitations of claims [12] and [25].

9.5.9. Dependent Claims 13 and 26

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

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

218. It is my opinion that for the same reasons set forth for [40] and [54] in Section 9.1.9, Pugel teaches the additional limitations of claims [13] and [26].

9.5.10. Dependent Claims 35, 36, 49, 50, 63, 64, 77 and 78

[35/36/63/64] “The cable TV device of claim [27/55], wherein: the DFE is operable to provide the plurality of desired channels via a [parallel/serial] interface.”

[49/50/77/78] “The cable TV device of claim [41/69], wherein: the plurality of digital down converters is operable to provide [a plurality of digital channel outputs, comprising] each digital channel output, via a [parallel/serial] interface.”

219. As I explained above in sections 9.1.1-9.1.4, Pugel teaches the base claims from which claims 35, 36, 49, 50, 63, 64, 77, and 78 depend. And for the same reasons set forth above in Sections 9.5.1, 9.5.2, and 9.5.5, Chandrakasan

teaches the additional limitations of these claims. Therefore, in my opinion, claims 35, 36, 49, 50, 63, 64, 77 and 78 are rendered obvious based on the combination of Pugel and Chandrakasan.

9.6. Ground F: Pugel in view of Chandrakasan and further in view of Crols

9.6.1. Dependent claims 3 and 16

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

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

220. As I explained above in Sections 9.5.1-9.5.2, Pugel in view of Chandrakasan teaches the base claims 1 and 14 from which claims 3 and 16 depend. And for the same reasons set forth above in Section 9.2.2, it is my opinion that Crols teaches the additional features of these claims. It is my opinion that modifying Pugel in view of Chandrakasan and further in view of Crols would have been obvious for the same rationales as discussed above, and the additional references would have presented no additional difficulties for the combination to a POSITA. Therefore, in my opinion, claims 3 and 16 are rendered obvious based on the combination of Pugel, Chandrakasan, and Crols.

9.6.2. Dependent claims 4 and 17

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

221. As I explained above in Section 9.6.1, Pugel in view of Chandrakasan and further in view of Crols teaches the base claims 3 and 16 from which claims 4 and 17 depend. And for the same reasons set forth above in Section 9.2.3, Crols teaches the additional features of these claims. It is my opinion that modifying Pugel in view of Chandrakasan and further in view of Crols would have been obvious for the same rationales as discussed above, and the additional references would have presented no additional difficulties for the combination to a POSITA. Therefore, in my opinion, claims 4 and 17 are rendered obvious based on the combination of Pugel, Chandrakasan, and Crols.

9.6.3. Dependent claims 6 and 19

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

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

222. As I explained above in Section 9.6.1, Pugel in view of Chandrakasan and further in view of Crols teaches the base claims 3 and 16 from which claims 6 and 19 depend. And for the same reasons set forth above in Section 9.2.4, it is my

opinion that Crols teaches the additional features of these claims. It is my opinion that modifying Pugel in view of Chandrakasan and further in view of Crols would have been obvious for the same rationales as discussed above, and the additional references would have presented no additional difficulties for the combination to a POSITA. Therefore, in my opinion, claims 6 and 19 are rendered obvious based on the combination of Pugel, Chandrakasan, and Crols.

9.7. Ground G: Pugel in view of Chandrakasan and further in view of Zaltsman

9.7.1. Dependent Claims 10 and 23

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

223. As I explained above in Sections 9.5.1-9.5.2, Pugel in view of Chandrakasan teaches the base claims 1 and 14 from which claims 10 and 23 depend. And for the same reasons set forth above in Section 9.3, Zaltsman teaches the additional features of claims 10 and 23. Modifying Pugel in view of Chandrakasan and further in view of Zaltsman would have been obvious for the same rationales as discussed above, and the additional references would have presented no additional difficulties for the combination to a POSITA. Therefore, in my opinion, claims 10 and 23 are rendered obvious based on the combination of Pugel, Chandrakasan, and Zaltsman.

9.8. Ground H: Pugel in view of Chandrakasan and further in view of Crols, Zaltsman, and Jensen '170

9.8.1. Dependent Claims 5 and 18

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

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

224. As I explain above in section 9.6.1, Pugel in view of Chandrakasan and Crols teaches the base claims 3 and 16 from which claims 5 and 18 depend. And it is my opinion that the same reasons set forth above in Section 9.4.1, Zaltsman and Jensen '170 teach the additional features of these claims. Modifying Pugel in view of Chandrakasan and Crols further in view of Zaltsman and Jensen '170 would have been obvious for the same rationales as discussed above, and the additional references would have presented no additional difficulties for the combination to a POSITA. Therefore, in my opinion, claims 5 and 18 are rendered obvious based on the combination of Pugel, Chandrakasan, Crols, Zaltsman, and Jensen '170.

10. CONCLUSION

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

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

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

CLAIMS LISTING APPENDIX

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

Designation	Claim Language
Claim 1	
[1A]	A cable television (TV) device comprising:
[1B]	a wideband analog-to-digital converter (ADC) configured to digitize a contiguous band of frequencies in an input signal, wherein the contiguous band of frequencies comprises a plurality of desired channels and a plurality of undesired channels; and
[1C]	a digital frontend (DFE) coupled to the wideband ADC, wherein the DFE is configured to concurrently select and provide each of the plurality of desired channels, via a serial interface, without providing any of the plurality of undesired channels.
Claim 2	
2	The cable TV device of claim 1, wherein: the cable TV device comprises a cable network connector, and the input signal is operably communicated from the cable network connector to the wideband ADC via at least one of an analog amplifier and an analog filter.
Claim 3	
3	The cable TV device of claim 1, wherein: the DFE comprises a plurality of mixers, and each mixer, of the plurality of mixers, is operable to generate a corresponding complex signal comprising an in-phase (I) component and a quadrature (Q) component.
Claim 4	
4	The cable TV device of claim 3, wherein: the I and Q components of each corresponding complex signal are at baseband.
Claim 5	
5	The cable TV device of claim 3, wherein: the DFE comprises a plurality of filters, and each filter, of the plurality of filters, is operable to filter the corresponding complex signal comprising a 6 MHz channel.
Claim 6	
6	The cable TV device of claim 3, wherein:

Designation	Claim Language
	the DFE comprises a plurality of digital demodulators, and each digital demodulator, of the plurality of digital demodulators, is operable to demodulate the corresponding complex signal.
Claim 7	
7	The cable TV device of claim 1, wherein: the DFE comprises a plurality of digital demodulators, and each digital demodulator, of the plurality of digital demodulators, is operable to demodulate a desired channel, of the plurality of desired channels.
Claim 8	
8	The cable TV device of claim 7, wherein: the DFE is operable to provide a plurality of demodulated desired channels via a parallel interface.
Claim 9	
9	The cable TV device of claim 1, wherein: the plurality of desired channels comprises at least one cable broadcast channel.
Claim 10	
10	The cable TV device of claim 1, wherein: the plurality of desired channels comprises at least one channel delivered via a Data Over Cable Service Interface Specification (DOCSIS) protocol.
Claim 11	
11	The cable TV device of claim 1, wherein: the cable TV device comprises a digital video recorder (DVR).
Claim 12	
12	The cable TV device of claim 1, wherein: the cable TV device is operable to configure at least some of the plurality of desired channels as an output for a picture-in-picture display.
Claim 13	
13	The cable TV device of claim 1, wherein: the contiguous band of frequencies comprises a portion of a frequency spectrum of the input signal.
Claim 14	
[14A]	A cable TV device comprising:

Designation	Claim Language
[14B]	a wideband analog-to-digital converter (ADC) configured to digitize an input signal, wherein the input signal comprises a plurality of desired channels and a plurality of undesired channels; and
[14C]	a plurality of digital down converters coupled to the wideband ADC, wherein each digital down converter, of the plurality of digital down converters, is operable to generate a digital channel output corresponding to each desired channel, of the plurality of desired channels, and
[14D]	wherein the plurality of digital down converters is operable to provide each digital channel output via a serial interface.
Claim 15	
15	The cable TV device of claim 14, wherein: the cable TV device comprises a cable network connector, and the input signal is operably communicated from the cable network connector to the wideband ADC via at least one of an analog amplifier and an analog filter.
Claim 16	
16	The cable TV device of claim 14, wherein: each digital down converter comprises a digital mixer operable to generate a corresponding complex signal comprising an in-phase (I) component and a quadrature (Q) component.
Claim 17	
17	The cable TV device of claim 16, wherein: the I and Q components of each corresponding complex signal are at baseband.
Claim 18	
18	The cable TV device of claim 16, wherein: each digital down converter comprises a filter operable to select the corresponding complex signal comprising a 6 MHz channel.
Claim 19	
19	The cable TV device of claim 16, wherein: each digital down converter comprises a digital demodulator operable to demodulate the corresponding complex signal to provide a demodulated channel as the digital channel output.
Claim 20	

Designation	Claim Language
20	The cable TV device of claim 14, wherein: each digital down converter comprises a digital demodulator operable to demodulate a desired channel, of the plurality of desired channels, to provide a demodulated channel as the digital channel output.
Claim 21	
21	The cable TV device of claim 20, wherein: the plurality of digital down converters is operable to provide a plurality of demodulated desired channels via a parallel interface.
Claim 22	
22	The cable TV device of claim 14, wherein: the plurality of desired channels comprises at least one cable broadcast channel.
Claim 23	
23	The cable TV device of claim 14, wherein: the plurality of desired channels comprises at least one channel delivered via a Data Over Cable Service Interface Specification (DOCSIS) protocol.
Claim 24	
24	The cable TV device of claim 14, wherein: the cable TV device comprises a digital video recorder (DVR).
Claim 25	
25	The cable TV of claim 14, wherein: the cable TV device is operable to provide a picture-in-picture display according to the plurality of digital channel outputs.
Claim 26	
26	The cable TV device of claim 14, wherein: the plurality of desired channels and the plurality of undesired channels comprise a portion of a frequency spectrum of the input signal.
Claim 27	
[27A]	A cable television (TV) device comprising:
[27B]	a wideband analog-to-digital converter (ADC) configured to digitize a contiguous band of frequencies in an input signal, wherein the contiguous band of frequencies comprises a

Designation	Claim Language
	plurality of desired channels and a plurality of undesired channels; and
[27C]	a digital frontend (DFE) coupled to the wideband ADC, wherein the DFE is configured to concurrently select and provide each of the plurality of desired channels without providing any of the plurality of undesired channels, and
[27D]	wherein the cable TV device comprises a digital video recorder (DVR).
Claim 28	
28	The cable TV device of claim 27, wherein: the cable TV device comprises a cable network connector, and the input signal is operably communicated from the cable network connector to the wideband ADC via at least one of an analog amplifier and an analog filter.
Claim 29	
[29A]	The cable TV device of claim 27, wherein:
[29B]	the DFE comprises a plurality of mixers, and
[29C]	each mixer, of the plurality of mixers, is operable to generate a corresponding complex signal comprising an in-phase (I) component and a quadrature (Q) component.
Claim 30	
30	The cable TV device of claim 29, wherein: the I and Q components of each corresponding complex signal are at baseband.
Claim 31	
[31A]	The cable TV device of claim 29, wherein:
[31B]	the DFE comprises a plurality of filters, and
[31C]	each filter, of the plurality of filters, is operable to filter the corresponding complex signal comprising a 6 MHz channel.
Claim 32	
[32A]	The cable TV device of claim 29, wherein:
[32B]	the DFE comprises a plurality of digital demodulators, and
[32C]	each digital demodulator, of the plurality of digital demodulators, is operable to demodulate the corresponding complex signal.
Claim 33	
[33A]	The cable TV device of claim 27, wherein:

Designation	Claim Language
[33B]	the DFE comprises a plurality of digital demodulators, and
[33C]	each digital demodulator, of the plurality of digital demodulators, is operable to demodulate a desired channel, of the plurality of desired channels.
Claim 34	
34	The cable TV device of claim 33, wherein: the DFE is operable to provide a plurality of demodulated desired channels via a parallel interface.
Claim 35	
35	The cable TV device of claim 27, wherein: the DFE is operable to provide the plurality of desired channels via a parallel interface.
Claim 36	
36	The cable TV device of claim 27, wherein: the DFE is operable to provide the plurality of desired channels via a serial interface.
Claim 37	
37	The cable TV device of claim 27, wherein: the plurality of desired channels comprises at least one cable broadcast channel.
Claim 38	
38	The cable TV device of claim 27, wherein: the plurality of desired channels comprises at least one channel delivered via a Data Over Cable Service Interface Specification (DOCSIS) protocol.
Claim 39	
39	The cable TV device of claim 27, wherein: the cable TV device is operable to configure at least some of the plurality of desired channels as an output for a picture-in-picture display.
Claim 40	
40	The cable TV device of claim 27, wherein: the contiguous band of frequencies comprises a portion of a frequency spectrum of the input signal.
Claim 41	
[41A]	A cable TV device comprising:
[41B]	a wideband analog-to-digital converter (ADC) configured to digitize an input signal, wherein the input signal comprises a

Designation	Claim Language
	plurality of desired channels and a plurality of undesired channels; and
[41C]	a plurality of digital down converters coupled to the wideband ADC, wherein each digital down converter, of the plurality of digital down converters, is operable to generate a digital channel output corresponding to each desired channel, of the plurality of desired channels, and
[41D]	wherein the cable TV device comprises a digital video recorder (DVR).
Claim 42	
[42A]	The cable TV device of claim 41, wherein:
[42B]	the cable TV device comprises a cable network connector, and
[42C]	the input signal is operably communicated from the cable network connector to the wideband ADC via at least one of an analog amplifier and an analog filter.
Claim 43	
43	The cable TV device of claim 41, wherein: each digital down converter comprises a digital mixer operable to generate a corresponding complex signal comprising an in-phase (I) component and a quadrature (Q) component.
Claim 44	
44	The cable TV device of claim 43, wherein: the I and Q components of each corresponding complex signal are at baseband.
Claim 45	
45	The cable TV device of claim 43, wherein: each digital down converter comprises a filter operable to select the corresponding complex signal comprising a 6 MHz channel.
Claim 46	
46	The cable TV device of claim 43, wherein: each digital down converter comprises a digital demodulator operable to demodulate the corresponding complex signal to provide a demodulated channel as the digital channel output.
Claim 47	
47	The cable TV device of claim 41, wherein:

Designation	Claim Language
	each digital down converter comprises a digital demodulator operable to demodulate a desired channel, of the plurality of desired channels, to provide a demodulated channel as the digital channel output.
Claim 48	
48	The cable TV device of claim 47, wherein: the plurality of digital down converters is operable to provide a plurality of demodulated desired channels via a parallel interface.
Claim 49	
49	The cable TV device of claim 41, wherein: the plurality of digital down converters is operable to provide a plurality of digital channel outputs, comprising each digital channel output, via a parallel interface.
Claim 50	
50	The cable TV device of claim 41, wherein: the plurality of digital down converters is operable to provide each digital channel output via a serial interface.
Claim 51	
51	The cable TV device of claim 41, wherein: the plurality of desired channels comprises at least one cable broadcast channel.
Claim 52	
52	The cable TV device of claim 41, wherein: the plurality of desired channels comprises at least one channel delivered via a Data Over Cable Service Interface Specification (DOCSIS) protocol.
Claim 53	
53	The cable TV of claim 41, wherein: the cable TV device is operable to provide a picture-in-picture display according to the plurality of digital channel outputs.
Claim 54	
54	The cable TV device of claim 41, wherein: the plurality of desired channels and the plurality of undesired channels comprise a portion of a frequency spectrum of the input signal.
Claim 55	

Designation	Claim Language
[55A]	A cable television (TV) device comprising:
[55B]	a wideband analog-to-digital converter (ADC) configured to digitize a contiguous band of frequencies in an input signal, wherein the contiguous band of frequencies comprises a plurality of desired channels and a plurality of undesired channels; and
[55C]	a digital frontend (DFE) coupled to the wideband ADC, wherein the DFE is configured to concurrently select and provide each of the plurality of desired channels without providing any of the plurality of undesired channels, and
[55D]	wherein the cable TV device is operable to configure at least some of the plurality of desired channels as an output for a picture-in-picture display.
Claim 56	
[56A]	The cable TV device of claim 55, wherein:
[56B]	the cable TV device comprises a cable network connector, and
[56C]	the input signal is operably communicated from the cable network connector to the wideband ADC via at least one of an analog amplifier and an analog filter.
Claim 57	
[57A]	The cable TV device of claim 55, wherein:
[57B]	the DFE comprises a plurality of mixers, and
[57C]	each mixer, of the plurality of mixers, is operable to generate a corresponding complex signal comprising an in-phase (I) component and a quadrature (Q) component.
Claim 58	
58	The cable TV device of claim 57, wherein: the I and Q components of each corresponding complex signal are at baseband.
Claim 59	
[59A]	The cable TV device of claim 57, wherein:
[59B]	the DFE comprises a plurality of filters, and
[59C]	each filter, of the plurality of filters, is operable to filter the corresponding complex signal comprising a 6 MHz channel.
Claim 60	
60	The cable TV device of claim 57, wherein:

Designation	Claim Language
	the DFE comprises a plurality of digital demodulators, and each digital demodulator, of the plurality of digital demodulators, is operable to demodulate the corresponding complex signal.
Claim 61	
61	The cable TV device of claim 55, wherein: the DFE comprises a plurality of digital demodulators, and each digital demodulator, of the plurality of digital demodulators, is operable to demodulate a desired channel, of the plurality of desired channels.
Claim 62	
62	The cable TV device of claim 61, wherein: the DFE is operable to provide a plurality of demodulated desired channels via a parallel interface.
Claim 63	
63	The cable TV device of claim 55, wherein: the DFE is operable to provide the plurality of desired channels via a parallel interface.
Claim 64	
64	The cable TV device of claim 55, wherein: the DFE is operable to provide the plurality of desired channels via a serial interface.
Claim 65	
65	The cable TV device of claim 55, wherein: the plurality of desired channels comprises at least one cable broadcast channel.
Claim 66	
66	The cable TV device of claim 55, wherein: the plurality of desired channels comprises at least one channel delivered via a Data Over Cable Service Interface Specification (DOCSIS) protocol.
Claim 67	
67	The cable TV device of claim 55, wherein: the cable TV device comprises a digital video recorder (DVR).
Claim 68	
68	The cable TV device of claim 55, wherein:

Designation	Claim Language
	the contiguous band of frequencies comprises a portion of a frequency spectrum of the input signal.
Claim 69	
[69A]	A cable TV device comprising:
[69B]	a wideband analog-to-digital converter (ADC) configured to digitize an input signal, wherein the input signal comprises a plurality of desired channels and a plurality of undesired channels; and
[69C]	a plurality of digital down converters coupled to the wideband ADC, wherein each digital down converter, of the plurality of digital down converters, is operable to generate a digital channel output corresponding to each desired channel, of the plurality of desired channels, and
[69D]	wherein the cable TV device is operable to provide a picture-in-picture display according to the plurality of digital channel outputs.
Claim 70	
70	The cable TV device of claim 69, wherein: the cable TV device comprises a cable network connector, and the input signal is operably communicated from the cable network connector to the wideband ADC via at least one of an analog amplifier and an analog filter.
Claim 71	
71	The cable TV device of claim 69, wherein: each digital down converter comprises a digital mixer operable to generate a corresponding complex signal comprising an in-phase (I) component and a quadrature (Q) component.
Claim 72	
72	The cable TV device of claim 71, wherein: the I and Q components of each corresponding complex signal are at baseband.
Claim 73	
73	The cable TV device of claim 71, wherein: each digital down converter comprises a filter operable to select the corresponding complex signal comprising a 6 MHz channel.
Claim 74	

Designation	Claim Language
74	The cable TV device of claim 71, wherein: each digital down converter comprises a digital demodulator operable to demodulate the corresponding complex signal to provide a demodulated channel as the digital channel output.
Claim 75	
75	The cable TV device of claim 69, wherein: each digital down converter comprises a digital demodulator operable to demodulate a desired channel, of the plurality of desired channels, to provide a demodulated channel as the digital channel output.
Claim 76	
76	The cable TV device of claim 75, wherein: the plurality of digital down converters is operable to provide a plurality of demodulated desired channels via a parallel interface.
Claim 77	
77	The cable TV device of claim 69, wherein: the plurality of digital down converters is operable to provide a plurality of digital channel outputs, comprising each digital channel output, via a parallel interface.
Claim 78	
78	The cable TV device of claim 69, wherein: the plurality of digital down converters is operable to provide each digital channel output via a serial interface.
Claim 79	
79	The cable TV device of claim 69, wherein: the plurality of desired channels comprises at least one cable broadcast channel.
Claim 80	
80	The cable TV device of claim 69, wherein: the plurality of desired channels comprises at least one channel delivered via a Data Over Cable Service Interface Specification (DOCSIS) protocol.
Claim 81	
81	The cable TV device of claim 69, wherein: the cable TV device comprises a digital video recorder (DVR).
Claim 82	

Designation	Claim Language
82	The cable TV device of claim 69, wherein: the plurality of desired channels and the plurality of undesired channels comprise a portion of a frequency spectrum of the input signal.