UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

COMCAST CABLE COMMUNICATIONS, LLC,
Petitioner,
v.
ENTROPIC COMMUNICATIONS, LLC,
Patent Owner.

Case No.: IPR2024-00432	Case No.: IPR2024-00435	Case No.: IPR2024-00438
Patent 9,210,362 B2	Patent 11,381,866 B2	Patent 11,399,206 B2
(Claims 1-20)	(Claims 1-82)	(Claims 1-76)

Before MICHELLE N. WORMMEESTER, JON M. JURGOVAN, and FREDERICK C. LANEY,
Administrative Patent Judges.

Petitioner's Demonstrative Exhibit

Introduction – Summary of the IPRs

Three challenged patents:

US 9,210,362 (Claims 1-20), US 11,381,866 (Claims 1-82), US 11,399,206 (Claims 1-76)

All three patents have the same priority and include identical disclosures.

Fig. 2 is representative of all independent claims

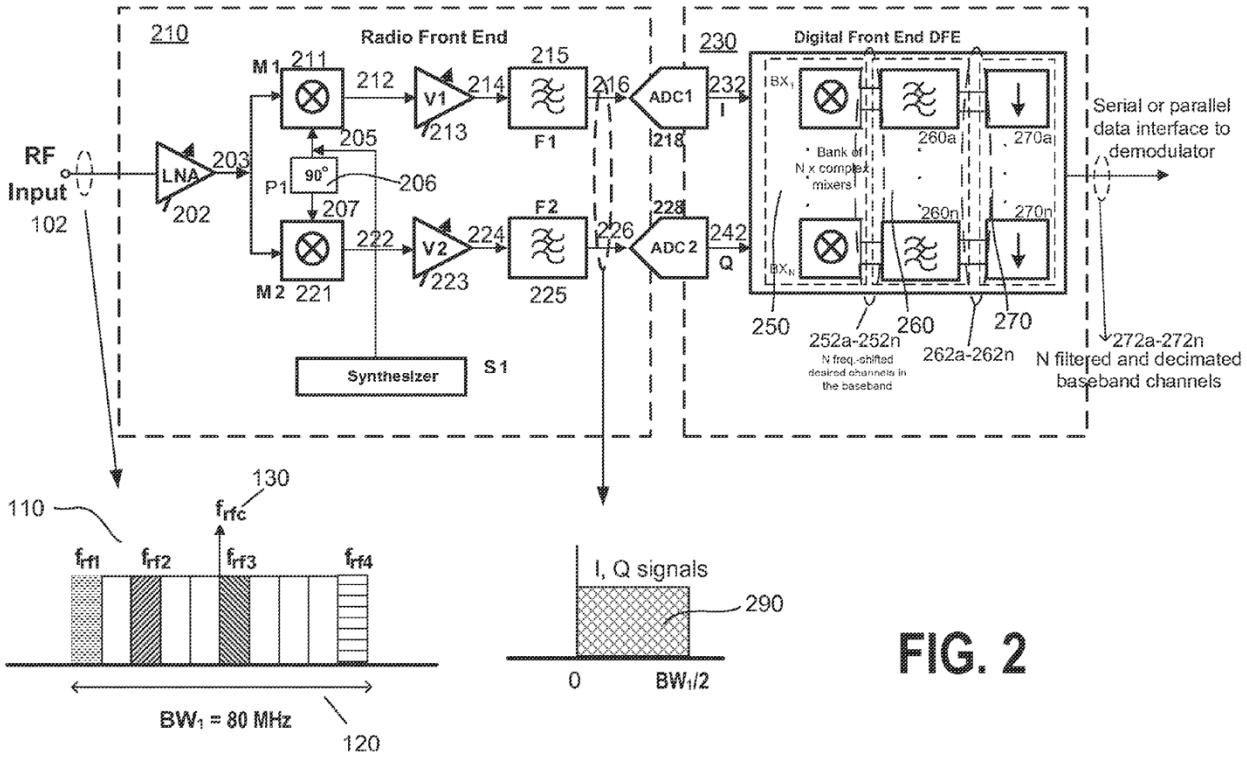


FIG. 2

(Ex. 1001 ('362 Patent), Fig. 2; '362 Pet., pp. 1-6; Ex. 1002 (Lett '362 Dec.), ¶¶ 36-42; '866 Pet., pp. 1-3; Ex. 1002 (Lett '866 Dec.), ¶¶ 39-41; '206 Pet., pp. 1-4; Ex. 1002 (Lett '206 Dec.), ¶¶ 36-38)

Overview of 362/866/206 Fig. 2 Embodiment

U.S. Prov. App. No. 61/170,526

The invention may be a single very wide-band tuner receiver RF1 which captures the desired swath of channels. This swath is amplified via a wide dynamic range low-noise amplifier LNA1 and mixed down into a complex signal path by I/Q mixers M1 and M2. The invention filters out unwanted portions of the spectrum via filters F1 and F2, and converts the signal to the digital domain using the wide band ADC converters ADC1 and ADC2. This portion of the system is similar to conventional tuners.

Ex. 1007 ('526 provisional), p. 5

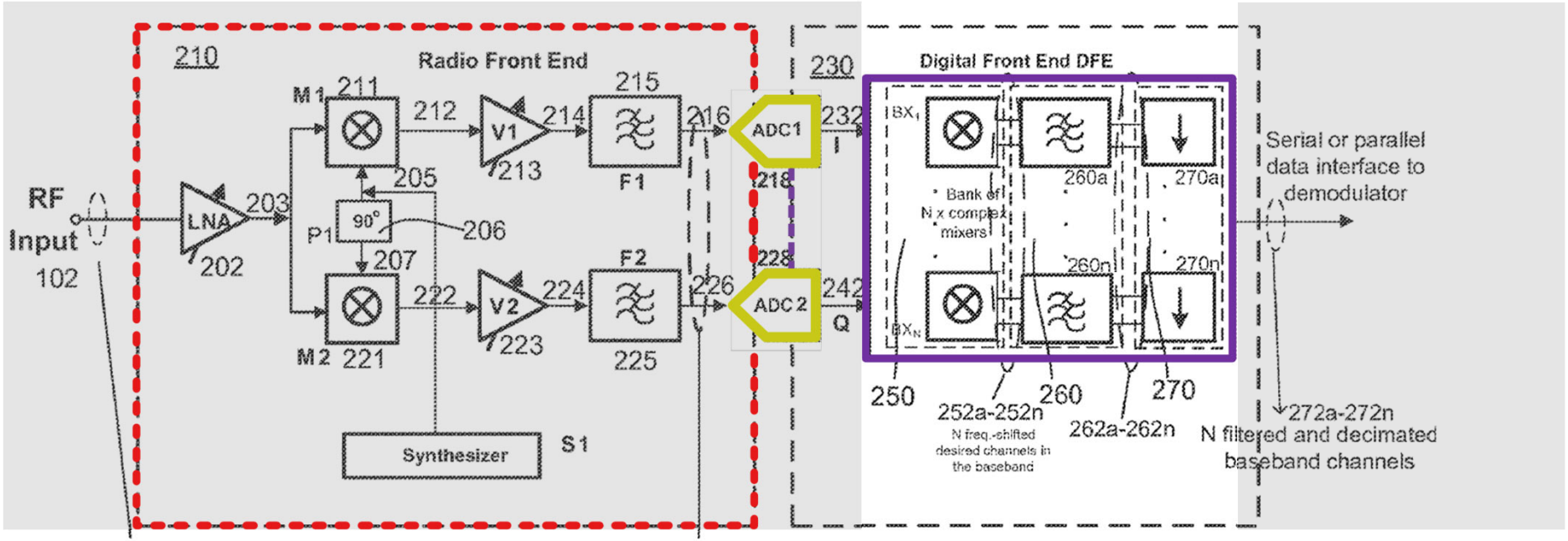
"conventional tuner[]"

'362 Patent

The reduced sampling rate of the N desired baseband channels 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, as shown in FIG. **2**.

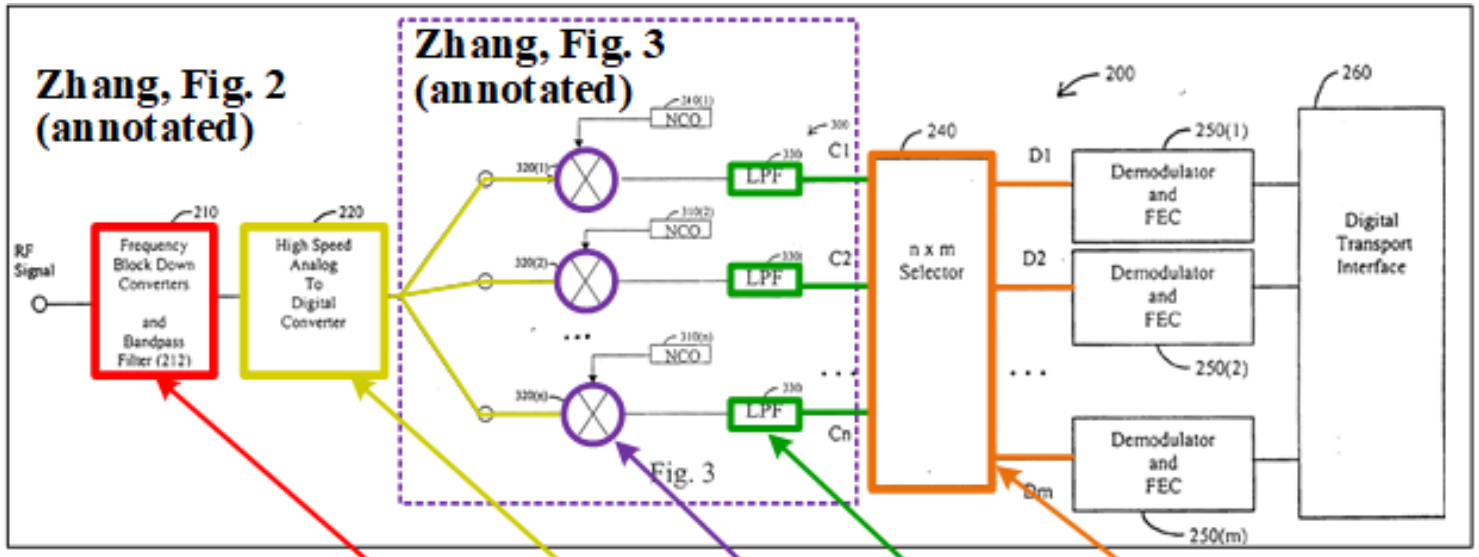
Ex. 1001 ('362 Pat.), 6:55-58

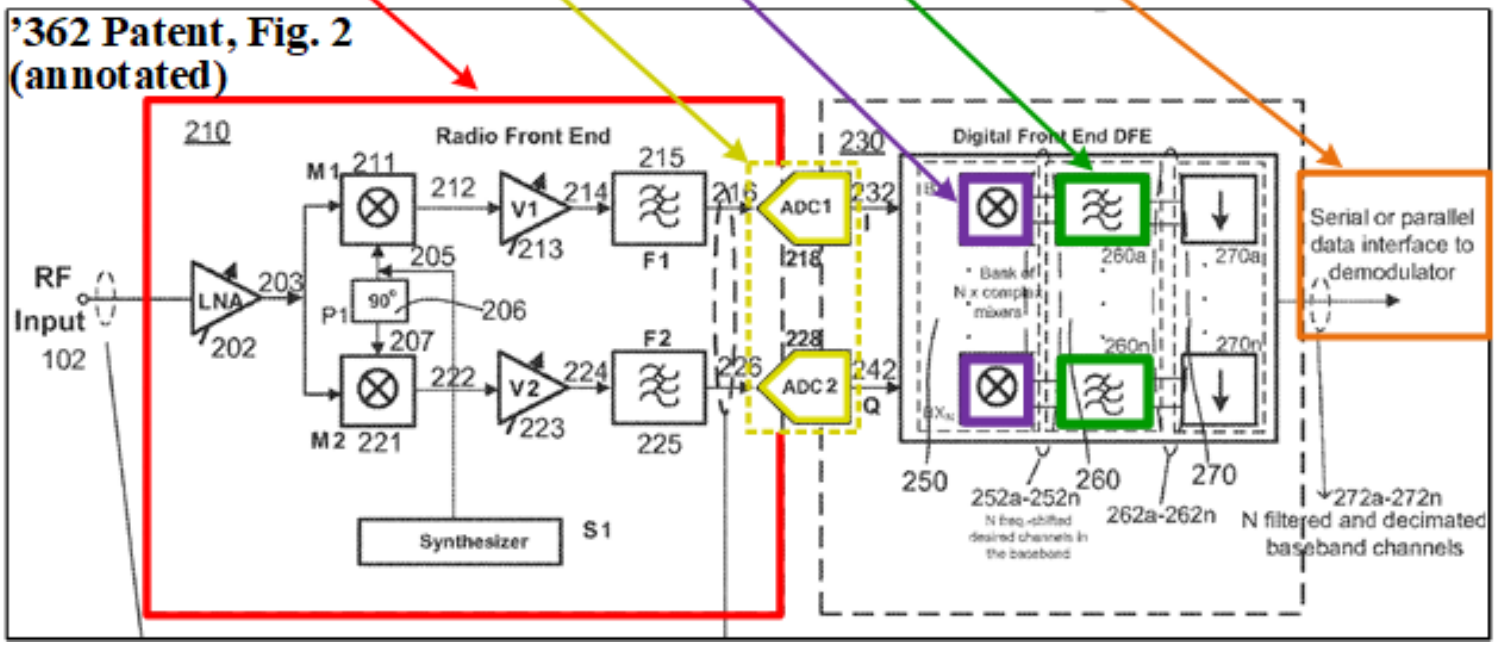
"commonly known"



('362 Pet., pp. 1,4, 6, 26, 31, 33, 40; Ex. 1002 (Lett '362 Dec.), ¶¶ 23, 38, 42, 85, 107, 117, 122, 136;
'866 Pet., pp. 1-3, 27, 44; Ex. 1002 (Lett '866 Dec.), ¶¶ 40, 41, 90, 117, 133, 158, 170;
'206 Pet., pp. 1-3, 28-29; Ex. 1002 (Lett '206 Dec.), ¶¶ 38, 87, 120, 154)

Zhang Compared to the Challenged Patents





Zhang and the challenged patents both include:

- An analog mixer module (red)
- An analog-to-digital converter module (gold)
- Digital down converters including:
  - multipliers (purple)
  - filters (green)
- A serial or parallel Interface (orange)

('362 Pet., pp. 8-11; Ex. 1002 (Lett '362 Dec.) ¶¶ 78-81; '866 Pet., pp. 4-7; Ex. 1002 (Lett '866 Dec.) ¶¶ 77-80; '206 Pet., pp. 5-8; Ex. 1002 (Lett '206 Dec.) ¶¶ 74-77)
('362 PO Resp., pp. 1-2, 17-18; '866 PO Resp., pp. 1-3, 19-20;'206 PO Resp., pp. 1-2, 16-17)

Zhang Compared to the Challenged Patents

Zhang and the challenged patents use the same circuit for selecting the desired channels and filtering out undesired channels.

Zhang

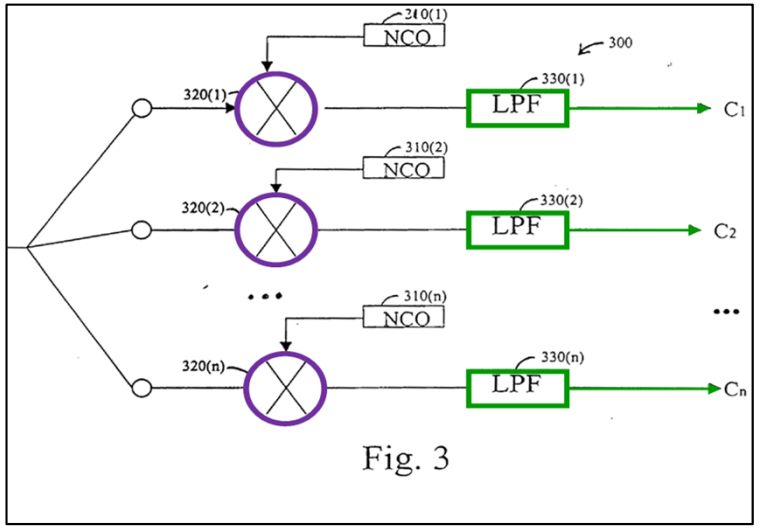
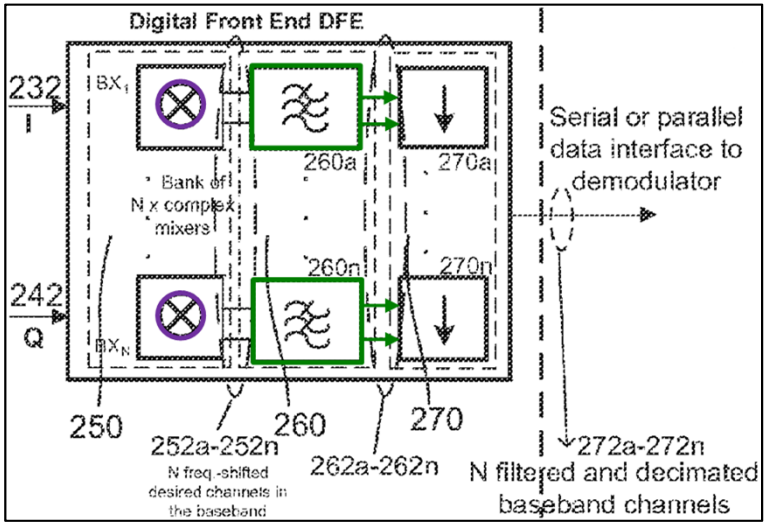


Fig. 3

Ex. 1013 (Zhang), Fig. 3 (annotated)

'362 Patent



Ex. 1001, Fig. 2 (annotated)

channel demultiplexer **230** of **FIG. 2**. Digital tuner **300** includes a bank of n numeric control oscillators (NCOs) **310(1** . . . n), complex multipliers **320(1** . . . n), and low-pass filters (LPFs) **330(1** . . . n). One chain of each of these elements is used for each RF channel. The exact number of these elements will depend on the number of RF channels to be demultiplexed. In this specific embodiment, low-pass filters **330** are high-speed finite impulse response (FIR) filters.

Ex. 1013 (Zhang), ¶ 30

of the analog filtered signal **226**. Digital signals I **232** and Q **242** are then applied to a bank of N complex mixers **250**, wherein N is an integer value corresponding to the number of desired RF channels located in the non-contiguous portions of the frequency spectrum BW1. It is understood that the

Ex. 1001, 5:31-35

('362 Pet., pp. 4, 22-30; '362 Reply, pp. 8-13; Ex. 1002 (Lett '362 Dec.), ¶¶ 98-114)

Zhang Compared to the Challenged Patents

Zhang and the challenged patents both disclose multiplier-filter circuits for the selection of desired channels and rejection of undesired channels.

Zhang

[0032] Numeric oscillator **310(1)** generates a frequency, or "target" frequency, that matches the characteristic frequency of a desired RF channel, or "target" RF channel. The output of NCO **310(1)** is multiplied by all the RF channels received at complex multiplier **320(1)**. When an multi-channel RF signal is multiplied with the output of NCO **310(1)**, the frequency of target RF channel signal is shifted to a desired channel. In some embodiments of the present invention, the target RF channel is shifted to a baseband, i.e., centered at DC. LPFs **330(1** . . . n) receive all RF channels and each filters out all RF channels except for its target RF channel. Thus, only the target RF channel passes. Accordingly, separate RF channels exit digital tuner **300**, i.e., the multi-channel RF signal is demultiplexed. Digital tuner circuit **300** then outputs the separated RF channels C_1 to C_n, each RF channel being centered at baseband.

Ex. 1013 (Zhang), ¶ 32

RF channels C_1 to C_n contain content channels that are selected or used by a subscriber. Channel-search capabilities

Ex. 1013 (Zhang), ¶28

37. The method of claim 34 further comprising filtering undesired RF channels and passing only the target RF channel.

Ex. 1013 (Zhang), Cl. 37

'362 Patent

$\sin(\omega_{ci}t)$ signals. Numerically controlled oscillators (NCO) can be implemented using a phase accumulator and a look-up table. NCOs are known to those of skill in the art and will not be described herein. The frequency ω_{ci} is so chosen that each one of the desired channels embedded in the digital signals I **232** and Q **242** will be downshifted to the baseband. In the given example shown in FIG. **2**, the bank of N complex mixers will have four complex mixers, each one of the N (i.e., four) complex mixers is coupled to an individual NCO having a distinct frequency ω_{ci} so that when mixing the filtered digital I and Q signals **312** and **322** with that frequency, each one of the complex mixers will generate the signals I (**318**) and Q (**328**) of a corresponding one of the desired channels at the baseband.

In an embodiment, baseband signals **318** and **328** are further individually filtered by respective filters **330** and **340** that are identified as one of the filters **260***a-n* in FIG. **2**. Filters **330** and **340** may be band-pass or low-pass filters having a narrow bandwidth equal to the bandwidth of a desired channel. In

Ex. 1001, 6:29-47

to commonly known methods, as shown in FIG. **2**. This approach provides several advantages over conventional tuner architectures. First, it eliminates the need of expensive data conversion, filtering and channel selection on the demodulator side. Second, it removes undesired channels from the signal path at an early stage, thus relieves the large dynamic range requirement in the demodulator.

Ex. 1001, 6:58-64

('362 Pet., p. 8-11, 26, 28-32; Ex. 1002 (Lett '362 Dec.) ¶¶ 78-81, 112-120;
'866 Pet., p. 4-7, 22-24; Ex. 1002 (Lett '866 Dec.) ¶¶ 77-80, 108-112;
'206 Pet., p. 5-8, 23-26; Ex. 1002 (Lett '206 Dec.) ¶¶ 74-77, 109-144)

Grounds of Invalidity - ’362 Patent

The only dispute is whether Zhang teaches the selection of desired channels as recited in the independent claims in red.

	References	Basis	Claims Challenged
A	Zhang	§102	**1**-3, 8, 9, **11**-13, 18, 19
B	Zhang	§103	**1**-3, 8, 9, **11**-13, 18, 19
C	Zhang-Pandey	§103	2, 3, 12, 13
D	Zhang-Mirabbasi	§103	1-6, 8-9, 14-16
E	Zhang-Mirabbasi-Karabinis	§103	7, 17
F	Zhang-Jensen	§103	10, 20
G	Zhang-Mirabbasi-Pandey	§103	2-3
H	Zhang-Mirabbasi-Jensen	§103	10

(’362 Pet., p. 18; Ex. 1002 (Lett ’362 Dec.), ¶ 19; ’362 PO Resp., pp. 1-3, 7-9; ’362 Reply, pp. 1-2)

Grounds of Invalidity - ’866 Patent

The only dispute is whether Zhang teaches the selection of desired channels as recited in the independent claims in red.

	References	Basis	Claims Challenged
A	Zhang	§102	**1**, 3-7, 9, 11, 13, **14**, 16-20, 22, 24, 26, **27**, 29-33, 35-37, 40, **41**, 43-47, 49-51, 54
B	Zhang	§103	**1**, 3-7, 9, 11, 13, **14**, 16-20, 22, 24, 26, **27**, 29-33, 35-37, 40, **41**, 43-47, 49-51, 54
C	Zhang-Reisman	§103	9-12, 22-25, **27**, 29-33, 35-40, **41**, 43-47, 49-54, **55**, 57-61, 63-68, **69**, 71-75, 77-82
D	Zhang-Jackson	§103	2-6, 15-19, 28-32, 42-46
E	Zhang-Reisman-Jackson	§103	28-32, 42-46, 56-60, 70-74
F	Zhang-Pandey	§103	1, 3-9, 11, 13, 14, 16-22, 24, 26, 34-36, 48-50
G	Zhang-Reisman-Pandey	§103	9-12, 22-25, 34-36, 48-50, 62-64, 76-78
H	Zhang-Pandey-Jackson	§103	2-6, 15-19

(’866 Pet., pp 10-14; Ex. 1002 (Lett ’866 Dec.), ¶¶ 19, 91-98 ; ’866 PO Resp., pp. 1-3, 9-11, 28-30; ’866 Reply, pp. 1-2)

Grounds of Invalidity - ’206 Patent

The only dispute is whether Zhang teaches the selection of desired channels as recited in the independent claims in red.

	References	Basis	Claims Challenged
A	Zhang	§102	**1**, 3-7, 9, 11, **13**, 15-19, 21, 23, **25**, 27-31, 33-35, **38**, 40-44, 46-48
B	Zhang	§103	**1**, 3-7, 9, 11, **13**, 15-19, 21, 23, **25**, 27-31, 33-35, **38**, 40-44, 46-48
C	Zhang-Reisman	§103	9-12, 21-24, **25**, 27-31, 33-37, **38**, 40-44, 46-50, **51**, 53-57, 59-63, **64**, 66-70, 72-76
D	Zhang-Jackson	§103	2-6, 14-18, 26-30, 39-43
E	Zhang-Reisman-Jackson	§103	26-30, 39-43, 52-56, 65-69
F	Zhang-Pandey	§103	1, 3-9, 11, 13, 15-21, 23, 32-34, 45-47
G	Zhang-Reisman-Pandey	§103	9-12, 21-24, 32-34, 45-47, 58-60, 71-73
H	Zhang-Pandey-Jackson	§103	2-6, 14-18

(’206 Pet., pp. 12-16; Ex. 1002 (Lett ’206 Dec.), ¶ 19, 88-95 ; ’206 PO Resp., pp. 1-3, 8-9, 36-38; ’206 Reply, pp. 1-2)

Overview of Challenged Independent Claims

'362 Patent, Claim 1

[1A] A wideband receiver system comprising:

[1B] a mixer module configured to downconvert a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;

[1C] a wideband analog-to-digital converter (ADC) module configured to digitize said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels;

[1D] digital circuitry configured to:
select said plurality of desired television channels from said digitized plurality of frequencies; and
output said selected plurality of television channels to a demodulator as a digital datastream.

'362 Patent, Figure 2

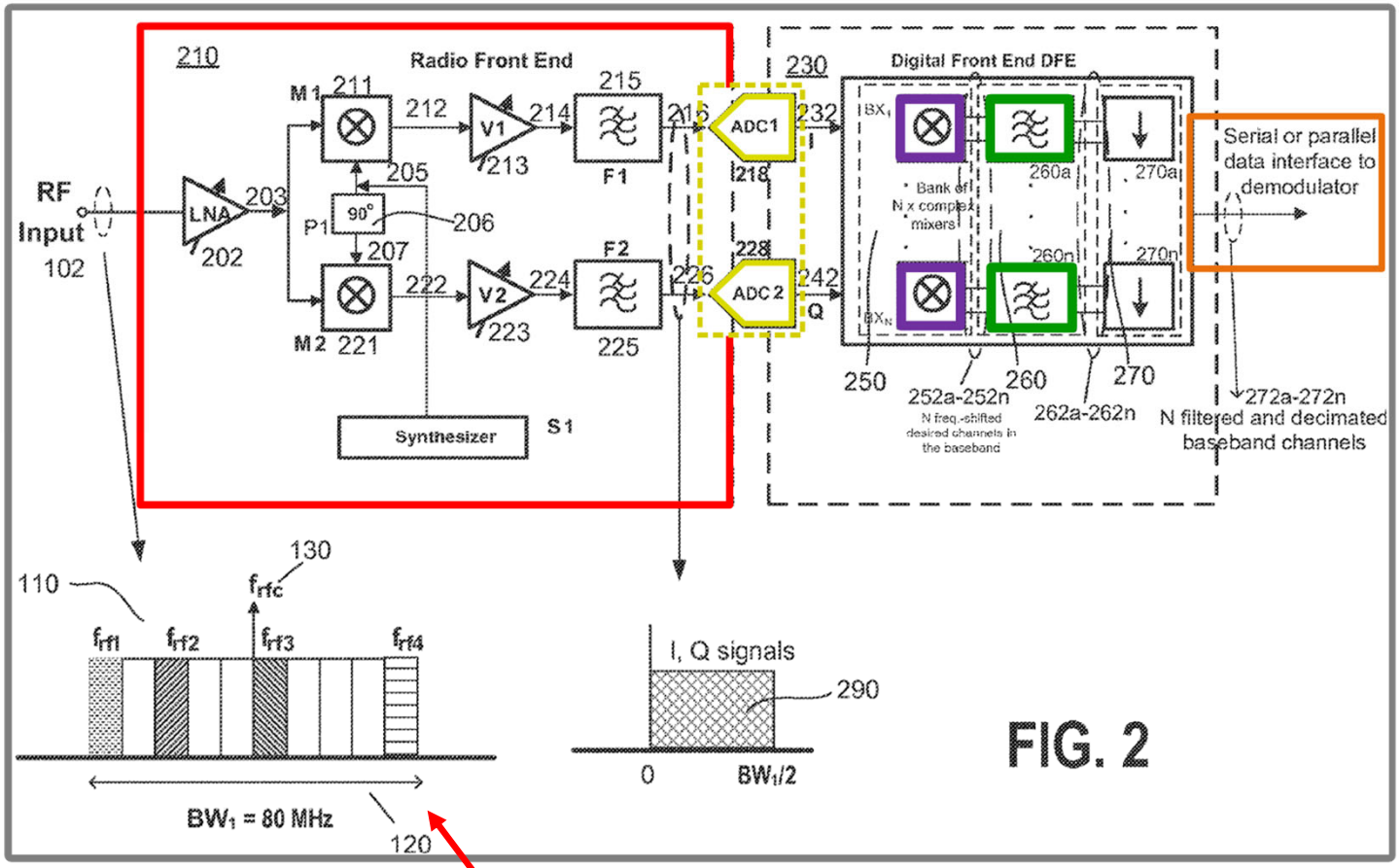


FIG. 2

**** Claim 11 is a method claim including substantially the same disputed limitation as claim 1.**

"desired" and "undesired" channels

(Ex. 1001 ('362 Pat.), Fig. 2 (annotated); '362 Pet., pp. 2-6, 9-11; Ex. 1002 (Lett '362 Dec.), ¶¶ 36-42, 79-81; '362 PO Resp., pp. 7-9)

Overview of Challenged Independent Claims

’866 Patent, 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.

Claims 27 and 55 include the same disputed limitation as claim 1, except for a “serial interface.”

’866 Patent, Claim 14

[14A] A cable TV device comprising:

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

[14C] a plurality of digital down converters coupled to the wideband ADC, wherein each digital down converter, of the plurality of digital down converters, is operable to generate a digital channel output corresponding to each desired channel, of the plurality of desired channels, and

[14D]wherein the plurality of digital down converters is operable to provide each digital channel output.

Claims 41 and 69 include the same disputed limitation as claim 14, except for a “serial interface.”

’206 Patent, Claim 1

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

[1B] receiving an input signal from a cable network;

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

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

[1E] providing the plurality of desired channels via a serial interface.

Claims 25 and 51 include the same disputed limitation as claim 1, except for a “serial interface.”

’206 Patent, Claim 13

[13A] A method comprising:

[13B] receiving an input signal from a cable network;

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

[13D] digitally down converting each desired channel, of the plurality of desired channels, to generate a plurality of digital channel outputs; and

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

Claims 38 and 64 include the same disputed limitation as claim 13, except for a “serial interface.”

(’866 Pet., pp.1-7, 32-34, 51; Ex. 1002 (Lett ’866 Dec.), ¶¶ 36-42, 79-81, 141-149; ’866 PO Resp., pp. 9-11, 28-30; ’206 Pet., pp. 2-6, 9-11, 42; Ex. 1002 (Lett ’206 Dec.), ¶¶ 36-42, 79-81, 141-149; ’206 PO Resp., pp. 8-9, 36-38)

The Disputed Desirable Channel Selection Limitations

digital circuitry configured to: select said plurality of desired television channels from said digitized plurality of frequencies;

'362 Patent, Element 1D

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.

'866 Patent, Element 1C

'866 Reply, p. 16

> Moreover, element [1C], reciting "without providing any of the plurality of undesired channels," makes clear that PO knew how to insert explicit negative limitations into claims when desired. While element [1C] excludes "providing" undesired channels, no such limitation appears with respect to "selecting" undesired channels.

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

'866 Patent, Element 14C

concurrently selecting each of the plurality of desired channels from the input signal **without selecting any of the plurality of undesired channels**;

'206 Patent, Element 1D

Only claims 1, 25, and 51 of the '206 patent include the "without selecting" negative limitation.

digitally down converting each desired channel, of the plurality of desired channels, to generate a plurality of digital channel outputs;

'206 Patent, Element 13D

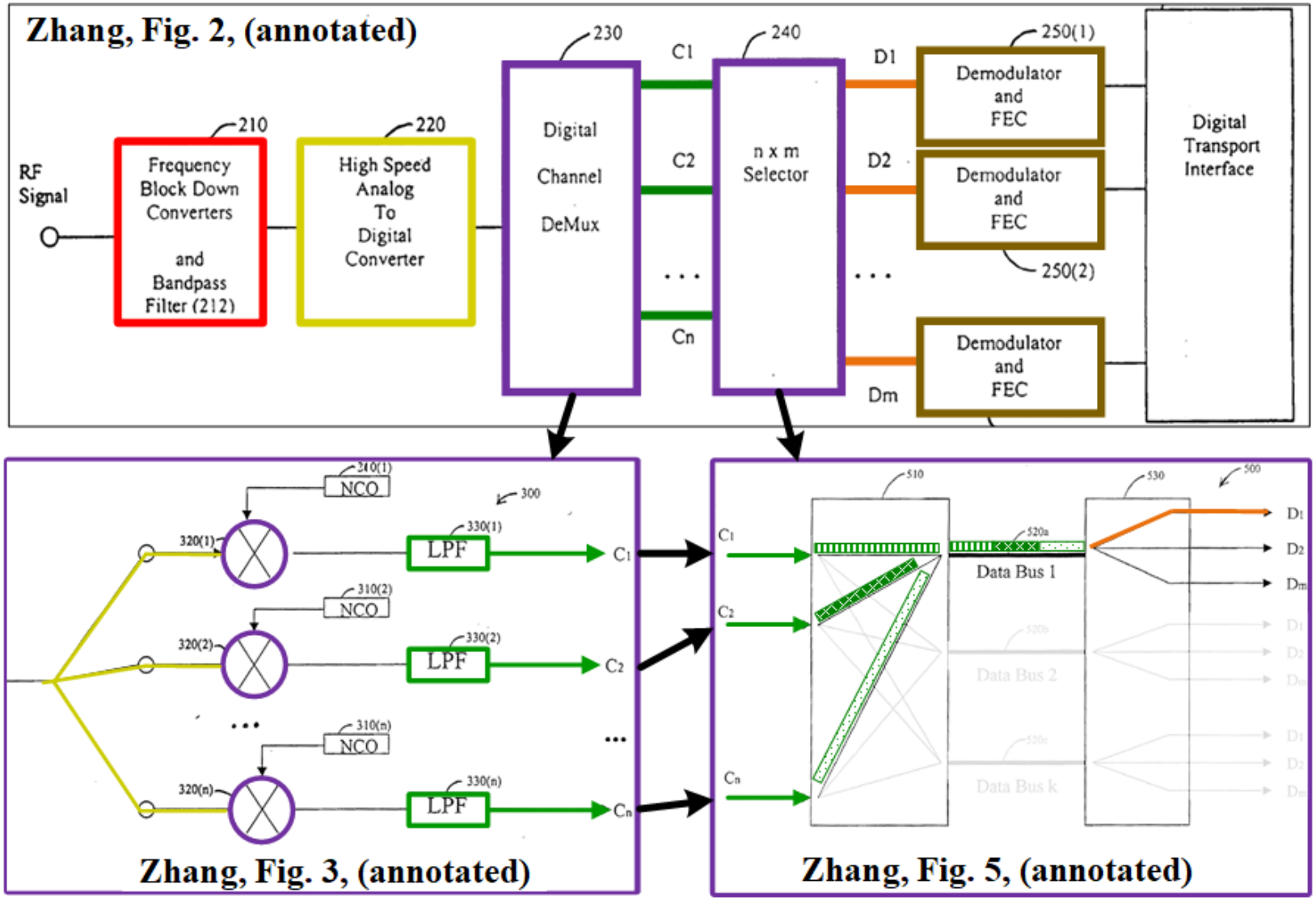
('362 PO Resp., pp. 7-9; '866 PO Resp., pp. 9-11, 28-30; '206 PO Resp., pp. 8-9, 36-38; '362 Reply, pp. 2, 22-25; '866 Reply, pp. 1-2, 15-18; '206 Reply, pp. 1-2, 21-25)

Chart Representative of All Disputed Limitations

Claim Element	Hardware Element	Selecting / Generating	Without Selecting	Outputting / Providing	Without Providing	Petition: Taught By Zhang
'362, [1C]	digital circuitry configured to:	**select** said plurality of desired television channels from said digitized plurality of frequencies		and output said selected plurality of television channels to a demodulator as a digital datastream		Demux 230 + Selector 240 **OR** Demux 230 alone
'866, [1C]	a digital frontend (DFE) … configured to	**concurrently select** and provide each of the plurality of desired channels**, via a serial interface**		concurrently select and **provide** each of the plurality of desired channels**, via a serial interface**	without providing any of the plurality of undesired channels.	Demux 230 + Selector 240
'866, [14C]	a plurality of digital down converters …	wherein each digital down converter … is **operable to generate** a digital channel output corresponding to each desired channel, of the plurality of desired channels		wherein the plurality of digital down converters is **operable to provide** each digital channel output, **via a serial interface**		Demux 230 + Selector 240
'206, [1D]	*NA*	**concurrently selecting** each of the plurality of desired channels from the input signal	without selecting any of the plurality of undesired channels	**providing** the plurality of desired channels **via a serial interface**		Demux 230 + Selector 240
'206, [13D]	*NA*	**digitally down converting** each desired channel, of the plurality of desired channels, **to generate** a plurality of digital channel outputs		**providing** the plurality of digital channel outputs via a serial interface		Demux 230 + Selector 240

('362 PO Resp., pp. 7-9; '866 PO Resp., pp. 9-11, 28-30; '206 PO Resp., pp. 8-9, 36-38 '362 Reply, pp. 2, 22-25; '866 Reply, pp. 1-2, 15-18; '206 Reply, pp. 1-2, 21-25)

Zhang's Circuits Relied Upon for Disclosing the Disputed Elements



('362 Pet., pp. 8-11; Ex. 1002 (Lett '362 Dec.) ¶¶ 78-81;
'866 Pet., pp. 4-7; Ex. 1002 (Lett '866 Dec.) ¶¶ 77-80;
'206 Pet., pp. 5-8; Ex. 1002 (Lett '206 Dec.) ¶¶ 74-77)

The Petitions Rely On Zhang's Demultiplexer 230 and Selector 240 for Teaching the Disputed Limitations

'362 Pet., p. 32

> Where $D_1 – D_m$ includes all C_1 - C_n, Digital Channel Demultiplexer 230 selects the desired channels and filters out the undesired channels as described above. Ex. 1002, ¶ 120. Alternatively, where $D_1 – D_m$ includes less than all channels C_1 - C_n, the combination of Digital Channel Demultiplexer 230 and Digital Selector 240 teaches the claimed selecting of the desired channels, in that a channel that is both demultiplexed by 230 and switched by 240 to a demodulator is "desired" and all other channels from the digital multi-channel RF signal are "undesired."

'866 Pet., p. 24

> Demultiplexer 230 and selector 240 output only user selected channels (either all or a subset of the user selected "C" channels) and filter out all other channels from the digitized multi-channel RF signal. Ex. 1013, [0028], [0032], [0039], [0047], claims 2, 30, 32; Ex. 1002, ¶ 112. Zhang thus discloses a DFE "configured to concurrently select and provide each of the plurality of desired channels … without providing any of the plurality of undesired channels" as recited in Element [1C].

'206 Pet., p. 26

> Demultiplexer 230 and Selector 240 output only user selected channels (either all or a subset of the user selected "C" channels) and filter out all other channels from the digitized multi-channel RF signal. Ex. 1013, [0028], [0039], [0047], claims 2, 30, 32; Ex. 1002, ¶ 113. Zhang thus discloses Element [1D]. Ex. 1002, ¶¶ 109-114.

The ’362 Petition Further Shows That Demultiplexer 230 Alone Taught the ’362 Patent Disputed Limitations Because the Independent Claims Lack a Serial Interface

Zhang’s Demultiplexer 230 Alone

’362 Pet., pp. 28-31

Zhang teaches the claimed “digital circuitry” as Digital Channel Demultiplexer 230, either alone, or in combination with all or part of Digital Selector 240 (**purple**). Ex. 1002, 111-125. In Zhang these are implemented with “standard

As shown below, Zhang uses the same technique described in the ’362 patent for selection and outputting of desired channels C_1 - C_n: first using a bank of complex mixers (**purple**) to frequency-shift a digitized version of the downconverted wideband signal so that each mixer outputs a different desired channel shifted to baseband (0 Hz), and then using low pass filters (**green**) to filter out the undesired channels so that only the desired channels remain.

Each of the desired channels is output by Digital Channel Demultiplexer 230 as a parallel digital data stream on parallel paths C_1 to C_n (**green**) to “one or more” shared demodulators 250(1)-250(m) via Bus Selector 240. *Compare* Ex. 1013, Figs. 2-3, [0029], [0032], claims 2-5, 9 *with* Ex. 1001, 6:55-58 (“N desired baseband channels will be sent as a serial or parallel digital data stream . . . according to commonly known methods, as shown in FIG. 2.”). Ex. 1002, ¶¶ 117-118, 121.

Thus, Digital Channel Demultiplexer 230 teaches Element [1D].

The ’362 Patent
Element [1D]

Petition’s Demultiplexer 230 Alone Argument*:
C1-Cn are the “desired television channels”

[1D] “digital circuitry configured to:

select said plurality of desired television channels from said digitized plurality of frequencies; and

output said selected plurality of television channels to a demodulator as a digital datastream.”

***Petition’s Demultiplexer 230 and Selector 240 Alternative Argument (D1-Dm are the “desired television channels”) is discussed below at slide 35.**

Zhang and the Challenged Patents Use the Same Structure and Operate in the Same Way for Selecting Desired Channels

'362 Patent, Element [1D]: "digital circuitry configured to: select said plurality of desired television channels from said digitized plurality of frequencies; and output said selected plurality of television channels to a demodulator as a digital datastream."

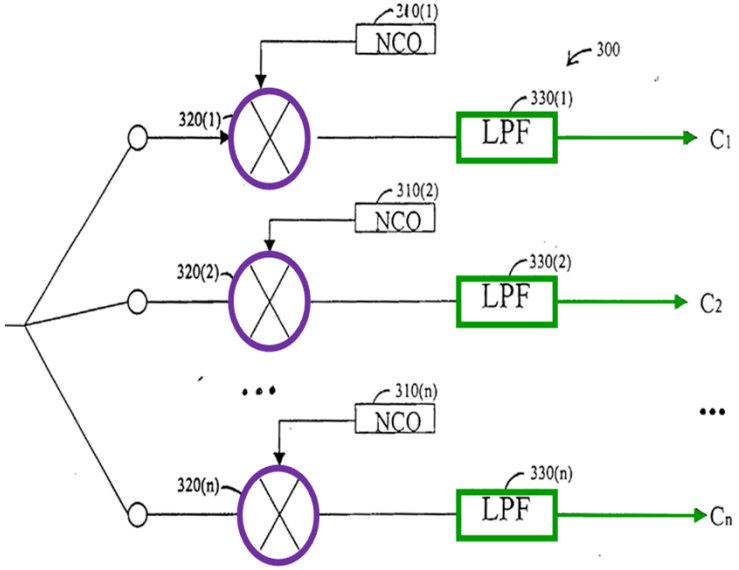
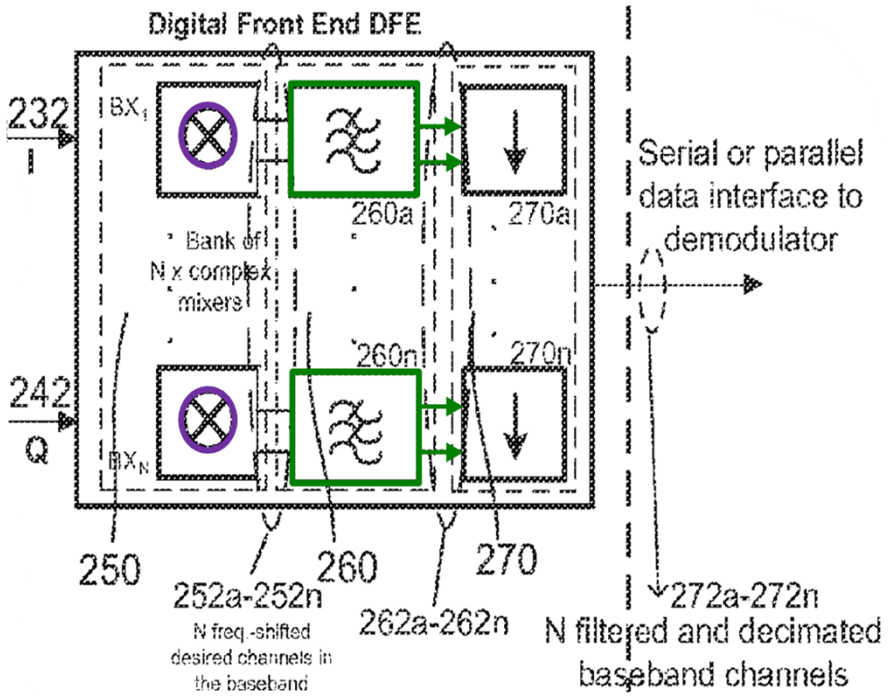


Fig. 3

Zhang, Fig. 3 (annotated)



'362 Patent, Fig. 2 (annotated)

('362 Pet., pp. 29-30; '362 Reply, pp. 8-12; Ex. 1002 (Lett '362 Dec.), ¶ 114)

Zhang's Fig. 3 Demultiplexer Selects and Outputs Desired Channels C1-Cn While Filtering Out Undesired Channels

'362 Patent, Element [1D]: "digital circuitry configured to: select said plurality of desired television channels from said digitized plurality of frequencies; and output said selected plurality of television channels to a demodulator as a digital datastream."

Zhang identifies each of **C1-Cn** as a "**desired RF channel,**" also referred to as target channels

Zhang filters out "**undesired RF channels**" and passes only the desired/target channels

Zhang, Fig. 3 (annotated)

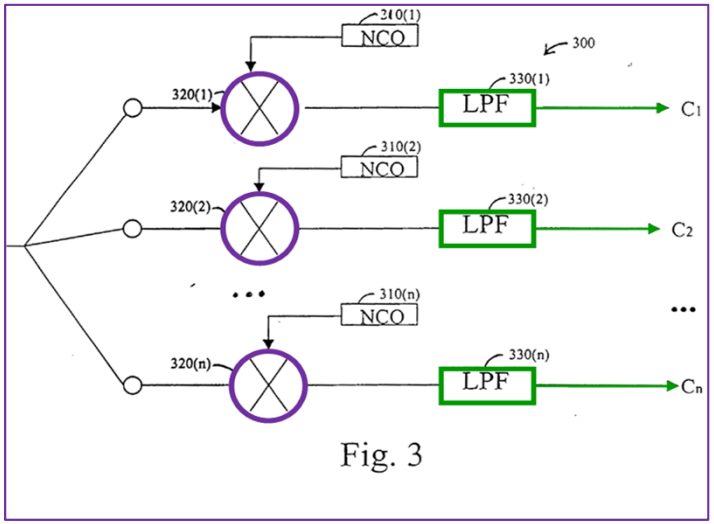


Fig. 3

Zhang, Ex. 1013 (Zhang), ¶ [0032]

[0032] Numeric oscillator **310(1)** generates a frequency, or "target" frequency, that matches the characteristic frequency of a desired RF channel, or "target" RF channel. The output of NCO **310(1)** is multiplied by all the RF channels received at complex multiplier **320(1)**. When an multi-channel RF signal is multiplied with the output of NCO **310(1)**, the frequency of target RF channel signal is shifted to a desired channel. In some embodiments of the present invention, the target RF channel is shifted to a baseband, i.e., centered at DC. LPFs **330(1** . . . n) receive all RF channels and each filters out all RF channels except for its target RF channel. Thus, only the target RF channel passes. Accordingly, separate RF channels exit digital tuner **300**, i.e., the multi-channel RF signal is demultiplexed. Digital tuner circuit **300** then outputs the separated RF channels C_1 to C_n, each RF channel being centered at baseband.

Zhang, Claim 37

37. The method of claim 34 further comprising filtering undesired RF channels and passing only the target RF channel.

('362 Pet, pp. 28-31; Ex. 1002 (Lett '362 Dec.), ¶¶ 111-118; Ex. 1013 (Zhang), ¶ [0032], Fig. 3, Cl. 37)

Zhang's C1-Cn are Desired Channels at Least Because They are "accessed," "used," and "selected" by a Subscriber

'362 Patent, Element [1D]: "digital circuitry configured to: select said plurality of desired television channels from said digitized plurality of frequencies; and output said selected plurality of television channels to a demodulator as a digital datastream."

Desired channels includes channels a user desires to watch

Zhang states that C1-Cn includes "**content**" and "**data streams**" that are:

- "**accessed … by a subscriber**"
- "**used by a subscriber**"
- "**selected …by a subscriber**"

Zhang, Ex. 1013, claim 3

3. The circuit of claim 2 wherein each separate digital RF channel comprises one or more data streams to be accessed or used by a subscriber.

Zhang, Ex. 1013, ¶ [0028]

RF channels C_1 to C_n contain content channels that are selected or used by a subscriber. Channel-search capabilities

('362 Pet, pp. 28-31; Ex. 1002 (Lett '362 Dec.), ¶¶ 111-118, 121; Ex. 1013 (Zhang), Cl. 3, ¶ [0028]; '362 Reply, pp. 20-21; Ex. 1078 (Lett '362 Reply Dec), ¶¶ 22-23)

PO's Argument: Zhang's "desired RF channel(s)" Include Undesired Channels

Patent Owner Argument:

Zhang's Channels C_1-C_n Include All Channels In The "Entire Signal Band," Both Desired And Undesired, Extracted Without Any "Selection."

('362 PO Resp., p. 10)

But Zhang Teaches:

- Zhang clearly teaches passing only desired RF channels and filtering out undesired RF channels.

Zhang, Ex. 1013, ¶ [0032]

[0032] Numeric oscillator **310(1)** generates a frequency, or "target" frequency, that matches the characteristic frequency of a desired RF channel, or "target" RF channel. The output of NCO **310(1)** is multiplied by all the RF channels received at complex multiplier **320(1)**. When an multi-channel RF signal is multiplied with the output of NCO **310(1)**, the frequency of target RF channel signal is shifted to a desired channel. In some embodiments of the present invention, the target RF channel is shifted to a baseband, i.e., centered at DC. LPFs **330(1** . . . n) receive all RF channels and each filters out all RF channels except for its target RF channel. Thus, only the target RF channel passes. Accordingly, separate RF channels exit digital tuner **300**, i.e., the multi-channel RF signal is demultiplexed. Digital tuner circuit **300** then outputs the separated RF channels C_1 to C_n, each RF channel being centered at baseband.

Zhang, Ex. 1013, Claim 37

37. The method of claim 34 further comprising filtering undesired RF channels and passing only the target RF channel.

('362 Pet, pp. 28-31; Ex. 1002 (Lett '362 Dec.), ¶¶ 111-118; Ex. 1013 (Zhang), ¶ [0032], Cl. 37)

PO Misinterprets "select said plurality of desired television channels" to Require "without selecting any undesired channels"

'362 Patent, Element [1D]: "digital circuitry configured to: select said plurality of desired television channels from said digitized plurality of frequencies; and output said selected plurality of television channels to a demodulator as a digital datastream."

Problems with PO's interpretation:

1. Element [1D] does not recite a negative limitation, and to read it into the claim would be legal error.
    - *Superguide Corp. v. DirecTV Enterprises, Inc.*, 358 F.3d 870, 874-875 (Fed. Cir. 2004).
2. The claims use the open-ended transition "comprising," and thus, do not exclude additional, unrecited steps, such as also selecting undesired channels.
    - *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 811 (Fed. Cir. 1999)

('362 Reply, pp. 22-25; PO Resp., p. 3)

PO Misinterprets "select said plurality of desired television channels" to Require "without selecting any undesired channels"

'362 Patent, Element [1D]: "digital circuitry configured to: select said plurality of desired television channels from said digitized plurality of frequencies; and output said selected plurality of television channels to a demodulator as a digital datastream."

3. The '362 Patent discloses embodiments that select **all** available or receivable channels without distinguishing between desired and undesired.
   - *Nobel Biocare Servs. AG v. Instradent U.S., Inc.*, 903 F.3d 1365, 1381 (Fed. Cir. 2018) ("[T]here is a strong presumption against a claim construction that excludes a disclosed embodiment.").
   - Patent Owner's Expert Declaration that the '362 Patent "only selects desired channels" is clearly contradicted by the '362 specification.

'362 Patent

of the analog filtered signal **226**. Digital signals I **232** and Q **242** are then applied to a bank of N complex mixers **250**, wherein N is an integer value corresponding to the number of desired RF channels located in the non-contiguous portions of the frequency spectrum BW1. It is understood that the number N can be any integer value. In one embodiment, N can be equal to the number of all available channels that exist in the licensed frequency spectrum to provide system flexibility. In other embodiments, N can be equal to the number of all receivable channels within a geographic area. In yet another

Ex. 1001, 5:31-40.

Patent Owner's Expert's Declaration

Specifically, the '362 patent ***only*** selects desired channels from the digitized input RF signal without selecting any undesired channels. In contrast, Zhang blindly extracts ***all*** channels, ***both*** desired and undesired, from the digitized input RF signal, and only later selects the desired channels from the extracted channels.

32. The Figure 2 embodiment of the '362 patent, annotated below, is illustrative. There, the analog input RF signal (yellow) is first digitized in the analog to digital converters (yellow). Ex. 1001 ['362] 5:28-31. Then, a bank of N mixers (blue) selects N desired channels, without selecting any undesired channels, from the digitized input RF signal. *Id.*, 5:31-37, 5:49-56.

('362 Reply, pp. 22-26)

'362 PO Resp. 3-4, Ex. 2009 (Russ-Decl.), ¶¶ 31-32

Contrary to Patent Owner's Position, Zhang Discloses Selecting Desired/Target Channels C1-Cn

'362 Patent, Element [1D]: "digital circuitry configured to: select said plurality of desired television channels from said digitized plurality of frequencies; and output said selected plurality of television channels to a demodulator as a digital datastream."

Zhang, Ex. 1013, ¶ [0032]

[0032] Numeric oscillator **310(1)** generates a frequency, or "target" frequency, that matches the characteristic frequency of a desired RF channel, or "target" RF channel. The output of NCO **310(1)** is multiplied by all the RF channels received at complex multiplier **320(1)**. When an multi-channel RF signal is multiplied with the output of NCO **310(1)**, the frequency of target RF channel signal is shifted to a desired channel. In some embodiments of the present invention, the target RF channel is shifted to a baseband, i.e., centered at DC. LPFs **330(1** . . . n) receive all RF channels and each filters out all RF channels except for its target RF channel. Thus, only the target RF channel passes. Accordingly, separate RF channels exit digital tuner **300**, i.e., the multi-channel RF signal is demultiplexed. Digital tuner circuit **300** then outputs the separated RF channels C_1 to C_n, each RF channel being centered at baseband.

Zhang, Ex. 1013, Claim 37

37. The method of claim 34 further comprising filtering undesired RF channels and passing only the target RF channel.

Zhang, Ex. 1013, ¶ [0028]

RF channels C_1 to C_n contain content channels that are selected or used by a subscriber. Channel-search capabilities

Dr. Russ's Declaration, Ex. 2009 ¶ [0055]

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

Patent Owner's Expert incorrectly testifies that "target channel" does not refer to a "desired channel."

('362 PO Resp., pp. 10-29; Ex. 1078 (Lett '362 Reply Dec.), ¶ 11; '362 Reply, pp. 15-17)

PO Argument That C1-Cn Discloses All Channels is Contrary to Zhang's Claims

'362 Patent, Element [1D]: "digital circuitry configured to: select said plurality of desired television channels from said digitized plurality of frequencies; and output said selected plurality of television channels to a demodulator as a digital datastream."

- Zhang claims "**one** or more" and "at least **one**" NCO/multiplier/filter.
- The variable "**n**" being **one** makes clear that the number of **C1-Cn** can be less than the number of channels in the "**multi-channel**" input.

Zhang, Ex. 1013, claims 17, 21.

17. The circuit of claim 16 wherein the polyphase channel demultiplexer comprises:

one or more low-pass filters (LPF) configured to receive the multi-channel digital RF signal and to synchronize the RF channels;

a discrete Fourier transform circuit (DFT) configured to receive the digital RF signal and to demultiplex the digital RF signal into separate RF channels.

21. A digital tuner for use in multi-channel demodulation, the digital tuner comprising:

at least one numeric control oscillator (NCO) configured to generate a select frequency, the select frequency being associated with a corresponding and separate RF channel;

at least one complex multiplier configured to receive a multi-channel digital RF signal and to multiply the multi-channel digital RF signal with the select frequency to obtain the corresponding and separate RF channel.

at least one low-pass filter (LPF) configured to receive the digital RF signal and to pass the corresponding RF channel.

Zhang, Fig. 3 (annotated)

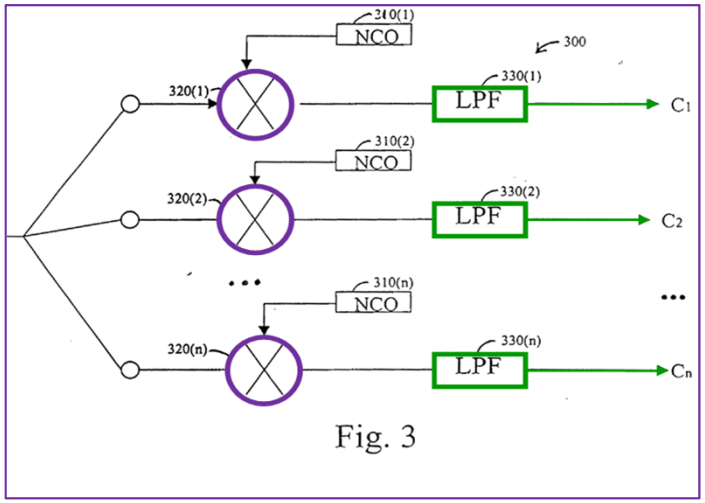


Fig. 3

('362 Pet., p. 29; '362 PO Resp., p. 22-25; '362 Reply, pp. 16-17)

PO Misapplies Zhang's ¶ [0027] to Argue That C1-Cn Includes All Channels and Misrepresents Petitioner's Expert's Testimony

'362 Patent, Element [1D]: "digital circuitry configured to: select said plurality of desired television channels from said digitized plurality of frequencies; and output said selected plurality of television channels to a demodulator as a digital datastream."

- Patent Owner incorrectly argues that paragraph [0027] of Zhang supports its position that C1-Cn includes all channels.
- This is the only support within Zhang that Patent Owner cites.
- Patent Owner also alleges that this fact is undisputed, citing only part of Petitioner's expert's testimony and misrepresenting his opinions.

'362 PO Resp., pp. 11-12

The letter "n" in Zhang denotes the number of channels, both desired and undesired, in the "entire signal band." For example, Zhang explains:

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

Ex. 1013 [Zhang] [0027]; Ex. 2009-[Russ-Decl.] ¶ 41.

This is undisputed and Petitioner's expert agreed that the number of channels "n" includes both desired and undesired channels:

> Q. So you agree that in paragraph 27 of Zhang, in the sentence that says, "In this specific embodiments" – "embodiment, ADC 220 is a high-speed ADC so an entire signal band with n channels can be converted," end quote. So you agree in this sentence, ***lower case letter n refers to both desired and undesired channels within the entire band***; correct?
>
> A. It seems to, ***yes***.

Ex. 2018 [Lett-1st-Depo.-Volume-I] 78:14-22.

('362 PO Resp., pp. 11-14; '362 Reply, p. 18)

Zhang's ¶ [0027] Does Not Support PO's Conclusion That C1-Cn Includes All Channels

'362 Patent, Element [1D]: "digital circuitry configured to: select said plurality of desired television channels from said digitized plurality of frequencies; and output said selected plurality of television channels to a demodulator as a digital datastream."

- Paragraph [0027] merely states that the ADC bandwidth has to be wide enough to include "n" desired channels.
- Paragraph [0027] does not say "n" includes undesired channels.
  - The ADC bandwidth must be wide enough to at least include all of the desired channels n and any non-contiguous/undesired frequency bands between the desired channels.
  - Zhang ¶ [0048], like the '362 patent, includes non-contiguous channels.

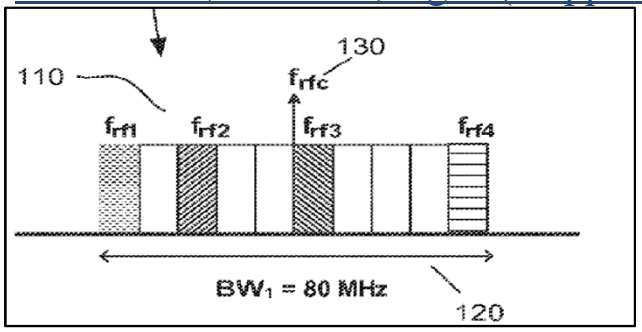
Zhang, Ex. 1013, ¶ [0027]

[0027] An ADC **220** then converts the down-converted multi-channel analog RF signal to a multi-channel digital RF signal. In this specific embodiment, ADC **220** is a high-speed ADC so that an entire signal band with n channels can be converted.

Zhang, Ex. 1013, ¶ [0048]

cations, and alternatives. For example, the RF channels can be in different frequency bands. Also, the RF channels need not be contiguous.

'362 Patent, Ex. 1001, Fig. 2 (cropped)



('362 PO Resp., pp. 11-14; '362 Reply, pp. 10, 18; '362 Pet., p. 24)

Zhang Compared to the Challenged Patents

Zhang and the challenged patents both disclose the desired channels being non-contiguous.

Zhang

It is to be understood that the implementations of FIGS. **2-6** are merely examples and should not limit the scope of the claims herein. In light of the present invention, one of ordinary skill in the art would recognize many other variations, modifications, and alternatives. For example, the RF channels can be in different frequency bands. Also, the RF channels need not be contiguous.

Ex. 1013 (Zhang), ¶ [0048]

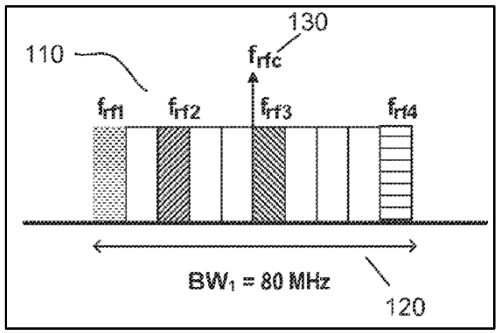
which are then sent to a demodulator. Because the swath of channels is not contiguous, this swath includes the desired channels as well as undesired channels. The demodulator

Ex. 1001 ('362 Patent), 1:29-31;
P.O. Sur-Reply p. 7

'362 Patent

FIG. **2** is a schematic block diagram of a wideband receiver system **200** according to an embodiment of the present invention. Wideband receiver system **200** includes a radio front end **210** and a digital front end **230**. Radio front end **210** may be a single very wide-band tuner receiver that captures the desired swath of channels located in non-contiguous portions of the spectrum having a frequency bandwidth BW1 **120**. In this example, the number of available channels in BW1 **120** is assumed to be 10 with each channel occupying an 8 MHz bandwidth for a total of 80 MHz. Radio front end **210** is shown as including a low noise amplifier LNA **202** having an input terminal configured to receive an RF input signal **102**. In the example shown, RF signal **102** includes four desired RF channels having the respective carrier frequency f_{rf1}, f_{rf2}, f_{rf3}, and f_{rf4} that are located in non-contiguous portions of the wide frequency spectrum BW1. It is understood, however,

Ex. 1001 ('362 Patent), 4:16-31



Ex. 1001 ('362 Patent), Fig. 2 (cropped)

('362 Pet., pp. 23-24, 62; Ex. 1002 (Lett '362 Dec.) ¶ 100; '362 Reply, p. 10; '866 Pet., pp. 4-7, 22; Ex. 1002 (Lett '866 Dec.) ¶¶ 77-80, 105; '866 Reply, p. 21; '206 Pet., pp. 5-8, 22; Ex. 1002 (Lett '206 Dec.) ¶¶ 74-77, 105; '206 Reply, p. 10)

Mr. Lett's Declaration Testimony Confirms That He is Not of the View That C1-Cn Includes Undesired Channels

Lett '362 Reply Declaration, Ex. 1078, ¶ 18

18. The Patent Owner's Response also identifies my declaration as allegedly supporting that C_1-C_n include all channels. POR, 14 (citing Ex. 1002, ¶ 79). The paragraph cited is a general background where I give an overview of Zhang based on one embodiment. I further explained in my detailed analysis of Zhang that n can be less than all channels that are in the multi-channel input. Ex. 1002, ¶¶ 104-106. I reiterated this during my deposition. Ex. 2018, 87:24-91:4.

'362 Reply, p. 18

Lett '362 Petition Declaration, Ex. 1002, ¶ 105

105. The '362 patent describes "desired" channels as those that are extracted from the RF input signal and sent to a demodulator and "undesired channels as those that are filtered out by the system. Ex. 1001, Abstract (The digital circuitry is configured to select the desired plurality of television channels from the digitized plurality of frequencies, and output the selected plurality of television channels to a demodulator"), 5:49-54 ("Each of the N complex mixers 250 … extract a different one of the desired channels"), 6:32-34 ("The frequency ω_{ct} is so chosen that each one of the desired channels … will be downshifted to the baseband."); 6:55-64 ([T]he N desired baseband channels will be sent … to a demodulator…. This approach … removes undesired channels…). Just like the '362 patent, Zhang's multi-channel analog RF signal comprises multiple RF carrier signals that include a plurality of desired television channels selected by a subscriber (e.g., C1, C2, C3 marked in green) and a plurality of undesired television channels (marked in red) to be filtered out. Ex. 1013, [0024], [0025], [0028], [0032], claims 2, 4, 34, 36, 37.

'362 Pet., p. 26

('362 PO Resp., p. 14; '362 Reply, p. 18)

PO Misrepresents Mr. Lett's Deposition Testimony – He is Not of the View That C1-Cn Includes All Channels

Ex. 1078 (Lett '362 Reply Dec.), ¶ 16

16. The Patent Owner's Response cites a single response in my deposition testimony in which I agreed that paragraph 27 of Zhang says "n" channels refers to both desired and undesired channels in the entire signal band from the ADC. POR, 11 (citing Ex. 2018, 78:14-22). I was answering specifically about **just one embodiment** disclosed by Zhang paragraph 27, "(In this specific embodiment, ADC **220** is a high-speed ADC so that an entire signal band with n channels **can be** converted.") *emphasis added*. The Patent Owner's Response leaves out that I go on to opine (before and after the portion of my deposition testimony cited in the POR) that Zhang discloses that "n" is a variable that can be equal to or less than all the channels in the signal band. Ex. 2018, 78:2-13, 79:17-80:10, 81:1-20, 83:10-14, 84:11-85:13, 85:24-86:12, 89:5-9.

Zhang, Ex. 1013, ¶ [0028]

RF channels C_1 to C_n contain content channels that are selected or used by a subscriber. Channel-search capabilities

Ex. 2018 (Lett Depo.), 81:1-10

Zhang is proposing a very flexible architecture in his invention. So as a design choice, one could choose to have C1 to C -- pick a number -- C5. Right. You could say, say I desire only five channels, right, for whatever reason. And you could input, say, 150 channels. And you could -- you could -- n would be 150 on the input. I mean, using the paragraph 27. But n is a variable, right. It could be a different number, depending on what you're talking about, right. So n, in my

Ex. 2018 (Lett Depo.), 78:2-22

Q Do you contend that the letter n, lower case letter n, refers to different things in different places in Zhang?
A It is hard to say. You know, he might have meant, you know, converting desired and undesired channels. He probably -- yeah. In this sentence, he is talking about digitizing the band, including desired and undesired channels. Whereas later -- and I -- I stand corrected a little bit on my statement. I just may -- later, he uses n with C with a subscript n -- n to indicate those are the selected or desired channels.
Q So you agree that in paragraph 27 of Zhang, in the sentence that says, "In this specific embodiments" -- "embodiment, ADC 220 is a high-speed ADC so an entire signal band with n channels can be converted," end quote. So you agree in this sentence, lower case letter n refers to both desired and undesired channels within the entire band; correct?
A It seems to, yes.

('362 PO Resp., pp. 11-14; '362 Reply, p. 18)

PO Wrongly Uses His Declaration Testimony – He Did Not Testify That C1-Cn Includes All Channels

Lett '362 Reply Declaration, Ex. 1078, ¶ 18

18. The Patent Owner's Response also identifies my declaration as allegedly supporting that C_1-C_n include all channels. POR, 14 (citing Ex. 1002, ¶ 79). The paragraph cited is a general background where I give an overview of Zhang based on one embodiment. I further explained in my detailed analysis of Zhang that n can be less than all channels that are in the multi-channel input. Ex. 1002, ¶¶ 104-106. I reiterated this during my deposition. Ex. 2018, 87:24-91:4.

'362 Reply, p. 18

Zhang, Ex. 1013, ¶ [0028]

RF channels C_1 to C_n contain content channels that are selected or used by a subscriber. Channel-search capabilities

Lett '362 Dec., Ex. 1002, ¶ 79

79. Zhang describes a multi-channel demodulator circuit 200 (illustrated by Figure 2 of Zhang reproduced above) that can be used as "advanced wide-band front-ends for digital set-top boxes, PVRs, home gateways and home media centers." Ex. 1013, [0044]-[0045], Fig. 8. The multi-channel demodulator circuit 200 receives a band of analog Radio Frequency (RF) signals comprising multiple content channels and only demodulates signals for those content channels that a subscriber has selected. Ex. 1013, [0011], [0024], [0028]-[0029], [0038]-[0040], [0042]. The Zhang multi-channel demodulator circuit comprises a frequency block down-converter 210 (**red**) that receives the band of analog RF signals and shifts the band to a lower frequency such that an analog-to-digital converter (**gold**) can better process the signal to convert the analog RF signals to digital RF signals. Ex. 1013, [0010], [0023], [0025], [0027], [0030]-[0037], [0041]-[0042]. A digital channel demultiplexer 230 (**green/purple**) then separates signals of all the content channels in the digital RF signals (e.g., channels C_1 to C_n), while a nxm digital selector 240 selects and forwards only signals for a subset of content channels selected by a subscriber (e.g., channels D_1 to D_m) to one or more of demodulators 250(1), 250(2), . . . 250(m) (**blue**), which may be "shared demodulators" with common functional blocks. Ex. 1013, [0010]-[0011], [0028]-[0029], [0042], [0047], claims 1, 4, 9, 31-32. The demodulators 250(1), 250(2), . . . 250(m) receive the signals of selected

('362 PO Resp., pp. 13-14; '362 Reply, p. 18; Ex. 1078 (Lett '362 Reply Dec.), ¶18)

PO's Citation to an EPO Application Corresponding to Zhang Does Not Support PO's Position

- PO cites this quoted statement from an EPO application that corresponds to Zhang.
- The statement in the EPO application about the selector distinguishing over D1 and D2 has nothing to do with what Zhang teaches with respect to C1-Cn.
- Even if the PO's position that D1 and D2 in conjunction with C1-Cn select the desired channels, Petitioner would still win under its alternative argument discussed beginning on Slide 35 below.

'362 PO Resp., pp.15-16 (citing Ex. 2011, 2-3)

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

('362 Reply, pp. 21-22)

PO's Assertion That Selector 240 is Only Needed Because C1-Cn Includes All Channels is Incorrect

- The presence of Selector 240 creates faster switching regardless of whether C1-Cn selects only desired channels as Zhang discloses or all channels as PO argues.
- Further, the Petition at p. 32 alternatively argues that the desired channels are either C1-Cn out of demultiplexer 230 **or** D1-Dm out of selector 240, making the PO's argument inconsequential. Petitioner wins under either scenario.

Zhang, Ex. 1013, ¶ [0028]

(FIGS. 2 and 3). Still referring to **FIG. 2**, an n×m digital selector **240** receives the demultiplexed digital RF channels C_1 to C_n and then selects one or more of the RF channels D_1 to D_m from one or more of the digital RF channels C_1 to C_n. RF channels C_1 to C_n contain content channels that are selected or used by a subscriber. Channel-search capabilities of the digital selector **240** renders it much faster than traditional analog channel switching through RF tuners. This is because only the selected channels are later demodulated unlike the systems using RF tuners which demodulate all of the RF channels. Embodiments of the present invention are not only faster but they dissipate less heat because fewer resources are required when demodulating only the selected RF channels.

('362 Reply, pp. 20-22)

'362 Pet., p. 32

Where $D_1 – D_m$ includes all C_1 - C_n, Digital Channel Demultiplexer 230 selects the desired channels and filters out the undesired channels as described above. Ex. 1002, ¶ 120. Alternatively, where $D_1 – D_m$ includes less than all channels C_1 - C_n, the combination of Digital Channel Demultiplexer 230 and Digital Selector 240 teaches the claimed selecting of the desired channels, in that a channel that is both demultiplexed by 230 and switched by 240 to a demodulator is "desired" and all other channels from the digital multi-channel RF signal are "undesired."

'362 PO Resp., p. 21 (quoting Ex. 2009 ['362 Russ-Dec.], ¶¶ 54-56)

Notably, if Zhang's digital channel demultiplexer 230 (as implemented in its Figure 3) demultiplexed only desired channels, that would negate the function of the digital channel selector 240 that follows the digital channel demultiplexer 230. As explained, the digital channel selector 240 takes the output of the digital channel demultiplexer 230 (channels C_1-C_n) as input, and selects and outputs desired channels D_1-D_m.

Zhang's Express Teachings Concerning C1-Cn and D1-Dm Contradict Patent Owner's Three Arguments

'362 Patent Owner Response, 25-27

Petitioner also argues that in the incidental situation where all of channels C_1-C_n separated out by Digital Channel Demultiplexer 230 are subsequently selected by the Selector 240, then the Digital Channel Demultiplexer 230 has extracted (and thus, supposedly selected) all desired channels. Pet., 32 ("Where D_1

First, Digital Channel Demultiplexer 230 blindly extracts all channels C_1-C_n in the "entire signal band," regardless of whether or not they are desired, or whether they will be ultimately selected by the channel selector 240. Thus, the Digital Channel Demultiplexer 230 does not "select" any channels even if all of its extracted channels are subsequently selected by the selector 240. Ex. 2009 [Russ-Decl.] ¶ 62.

Second, Petitioner does not point to any disclosure in Zhang that teaches or suggests that all extracted channels C_1-C_n could be the desired channels D_1-D_m. As Petitioner's expert explained, Zhang by design extracts more channels from the input signal than are desired (*i.e.*, Zhang extracts all channels) so that new desired channels can be selected without having to extract them from the input signal. Ex. 2019 [Lett-1st-Depo-Volume-II] 8:408, 8:14-22.

Third, the theoretical happenstance that all extracted channels C_1-C_n could be the desired channels D_1-D_m cannot disclose the claimed method; for that would mean that it makes no difference whether all channels are desired, or are not desired, or if no one had ever conceived of using the distinction between desired and undesired channels at all. *In re Facebook, Inc.*, 743 Fed Appx. 998, 1001-

For the foregoing reasons, Petitioner's arguments contradict Zhang's express disclosures.

Zhang, Ex. 1013, Claim 3

3. The circuit of claim 2 wherein each separate digital RF channel comprises one or more data streams to be accessed or used by a subscriber.

Zhang, Ex. 1013, ¶ [0028]

RF channels C_1 to C_n contain content channels that are selected or used by a subscriber. Channel-search capabilities

Zhang, Ex. 1013, ¶ [0032]

[0032] Numeric oscillator **310(1)** generates a frequency, or "target" frequency, that matches the characteristic frequency of a desired RF channel, or "target" RF channel. The output

Zhang, Ex. 1013, Claim 21

21. A digital tuner for use in multi-channel demodulation, the digital tuner comprising:

at least one numeric control oscillator (NCO) configured to generate a select frequency, the select frequency being associated with a corresponding and separate RF channel;

at least one complex multiplier configured to receive a multi-channel digital RF signal and to multiply the multi-channel digital RF signal with the select frequency to obtain the corresponding and separate RF channel.

at least one low-pass filter (LPF) configured to receive the digital RF signal and to pass the corresponding RF channel.

Zhang, Ex. 1013, ¶ [0028]

(FIGS. 2 and 3). Still referring to **FIG. 2**, an n×m digital selector **240** receives the demultiplexed digital RF channels C_1 to C_n and then selects one or more of the RF channels D_1 to D_m from one or more of the digital RF channels C_1 to C_n.

('362 Pet, pp. 28-33; Ex. 1002 (Lett '362 Dec.), ¶¶ 111-125; '362 Pet. Reply, pp. 22-25)

The ’362 Patent Element [1D]

Petition’s Demultiplexer 230 and Selector 240 Alternative Argument: D1-Dm are the “desired television channels”

[1D] “digital circuitry configured to:

select said plurality of desired television channels from said digitized plurality of frequencies; and

output said selected plurality of television channels to a demodulator as a digital datastream.”

Alternative Argument: Demultiplexer 230 and Selector 240: D1-Dm are the "desired television channels" Output by a Combination of Zhang's Demultiplexer 230 and Selector 240

[1D] "digital circuitry configured to: select said plurality of desired television channels from said digitized plurality of frequencies; and output said selected plurality of television channels to a demodulator as a digital datastream."

'362 Pet., p. 32

Where $D_1 - D_m$ includes all C_1 - C_n, Digital Channel Demultiplexer 230 selects the desired channels and filters out the undesired channels as described above. Ex. 1002, ¶ 120. Alternatively, where $D_1 - D_m$ includes less than all channels C_1 - C_n, the combination of Digital Channel Demultiplexer 230 and Digital Selector 240 teaches the claimed selecting of the desired channels, in that a channel that is both demultiplexed by 230 and switched by 240 to a demodulator is "desired" and all other channels from the digital multi-channel RF signal are "undesired."

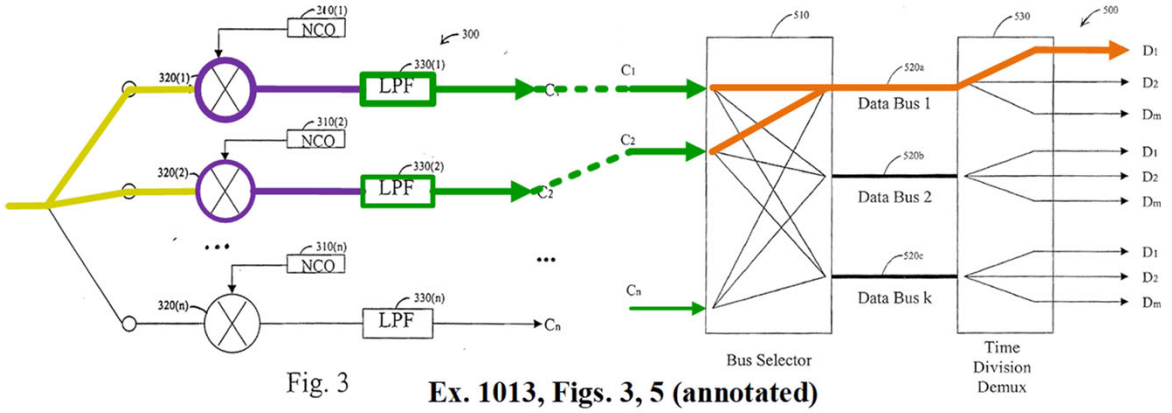


Fig. 3

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

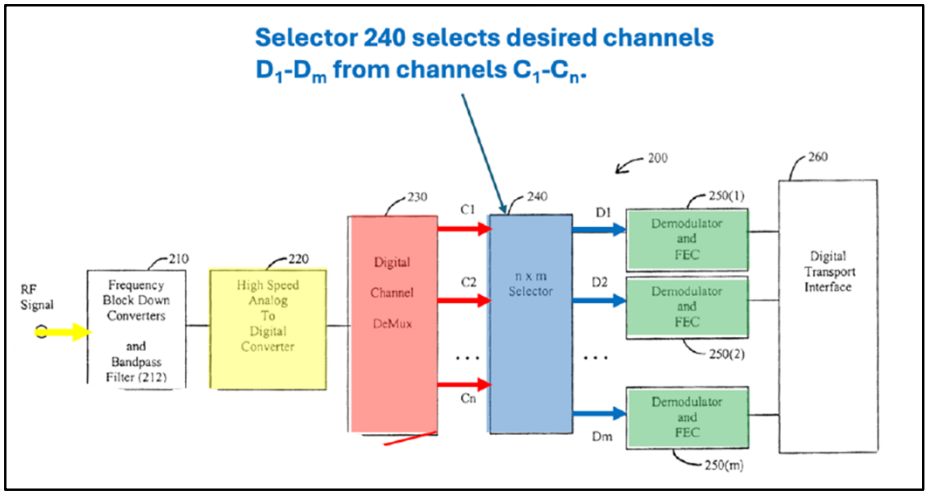
('362 Pet, pp. 31-33; Ex. 1002 (Lett '362 Dec.), ¶¶ 119-122; Ex. 1013 (Zhang), Figs. 2, 3, 5)

PO's Strawman Argument that Selector 240 Alone is the Digital Circuitry Performing the Selection Does Not Address Petitioner's Actual Argument That the Combination of 230 and 240 is the Digital Circuitry Performing the Selection

Patent Owner asserts that 240 alone performs the claimed selection, but not from "the plurality of frequencies"

'362 PO Resp, pp. 13-14, 29

To the extent Petitioner relies on channels D_1-D_m as the claimed "plurality of desired television channels," that reliance fails to disclose or render obvious the claims because channels D_1-D_m are not selected "from" the same "plurality of frequencies" down converted and digitized in limitations 1[b] and 1[c], as required.



('362 PO Resp., pp. 29-35; '362 Reply, pp. 7-13)

But, the Petition did not assert that 240 **alone** performs the claimed selection, rather the petition asserted that **230 and 240 in combination** are the claimed "digital circuitry" that performs the selection.

'362 Pet., pp. 29, 32

Alternatively, where $D_1 - D_m$ includes less than all channels C_1 - C_n, the combination of Digital Channel Demultiplexer 230 and Digital Selector 240 teaches the claimed selecting of the desired channels, in that a channel that is both demultiplexed by 230 and switched by 240 to a demodulator is "desired" and all other channels from the digital multi-channel RF signal are "undesired."

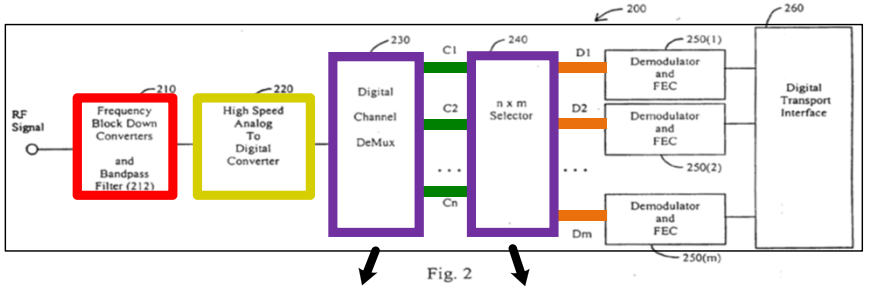


Fig. 2

230 and 240 in combination are the claimed "digital circuitry" that performs the selection

Zhang's "digital circuitry" (demultiplexer 230 and selector 240) Receives "said plurality of frequencies" and Outputs Only "desired television channels"

The input of Zhang's digital circuitry receives "said digitized plurality of frequencies"

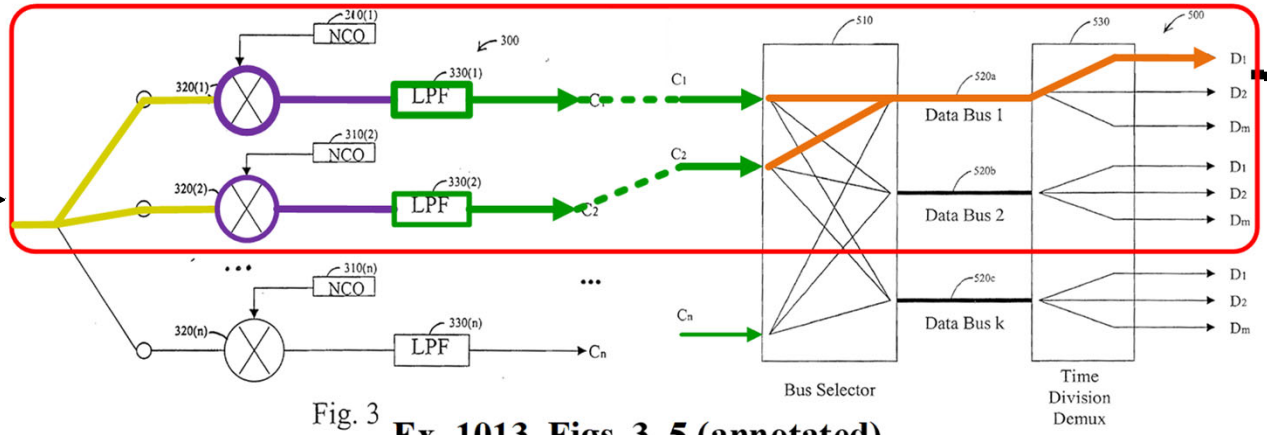
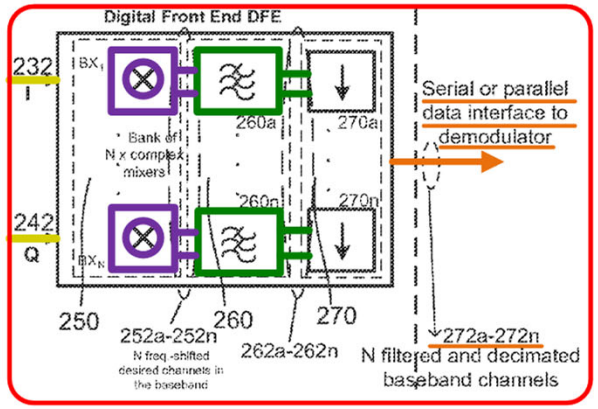


Fig. 3

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

The output of Zhang's digital circuitry outputs "desired television channels"

The input of the '362's digital circuitry receives "said plurality of frequencies"



Ex. 1001, Fig. 2 (annotated)

The output of the '362's digital circuitry outputs "desired television channels"

('362 PO Resp., pp. 29-35; '362 Reply, pp. 7-13; '362 Pet., pp. 29-30; Ex. 1002 (Lett '362 Dec.), ¶ 114)

The ’866 Patent
Elements [1C] and [14C]-[14D]

[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.

Elements 27C and 55C include the same disputed limitation as element 1C (except for the “serial interface”)

[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,

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

Elements 41C and 69C include the same disputed limitation as element 14C.

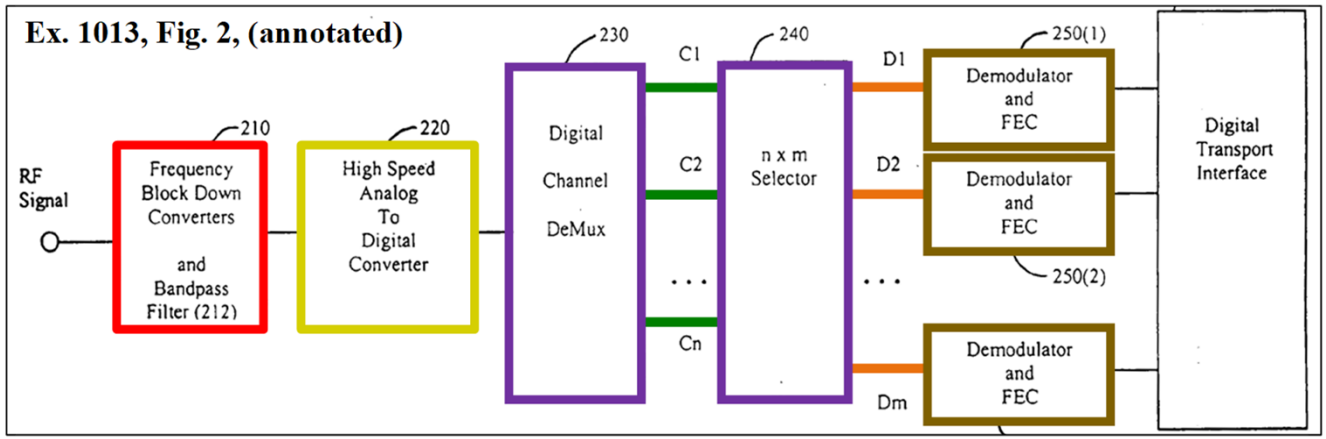
’866 Patent – Zhang (Disputed Limitations)

’866 Pet., p. 24

Demultiplexer 230 and selector 240 output only user selected channels (either all or a subset of the user selected “C” channels) and filter out all other channels from the digitized multi-channel RF signal. Ex. 1013, [0028], [0032], [0039], [0047], claims 2, 30, 32; Ex. 1002, ¶ 112. Zhang thus discloses a DFE “configured to concurrently select and provide each of the plurality of desired channels … without providing any of the plurality of undesired channels” as recited in Element [1C].

’866 Pet., p. 30

As shown below, Zhang’s demultiplexer 230 (the claimed “plurality of digital down converters”) provides channels C_1-C_n (light blue) (which include each claimed “digital channel output”) via a selector 240 as channels D_1-D_m to one or more demodulators 250. Ex. 1013, [0005], [0028], [0038]-[0039], [0047], claims 2-4, 30; Ex. 1002, ¶¶ 129-130. Embodiments of selector 240 use a serial interface.



(’866 Pet, pp. 22-25, 28-30; Ex. 1002 (Lett ’866 Dec.), ¶¶ 109-112, 123-128; Ex. 1013 (Zhang), Fig. 2)

Zhang's Demultiplexer/Selector "select[s] and provide[s] each of a plurality of desired channels"

Zhang, Fig. 3, (annotated)

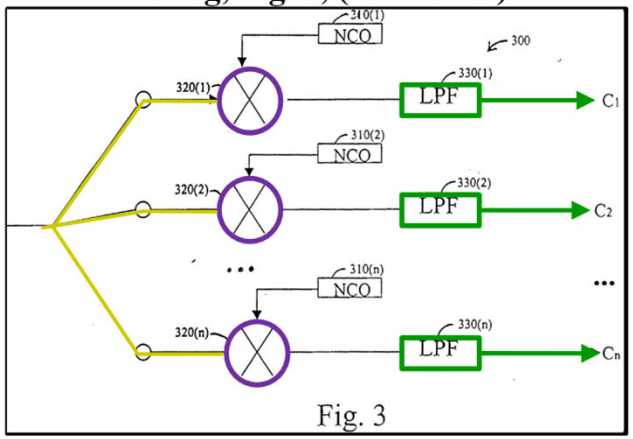
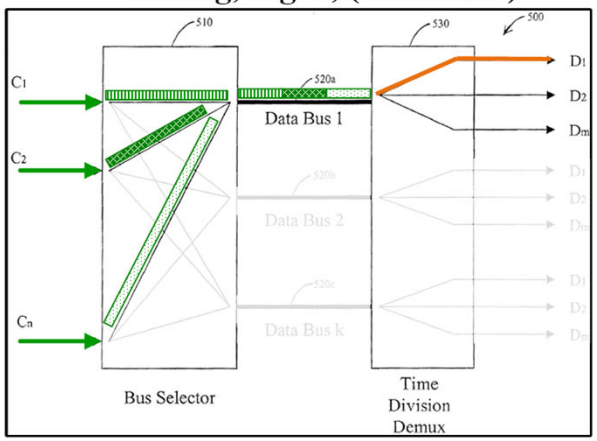


Fig. 3

Zhang, Fig. 5, (annotated)



'866 Patent, Element [1C]: "digital front end … configured to

concurrently select and provide each of a plurality of desired channels,

via a serial interface,

without providing any of the plurality of undesired channels"

Zhang, Ex. 1013, ¶ [0032]

[0032] Numeric oscillator **310(1)** generates a frequency, or "target" frequency, that matches the characteristic frequency of a desired RF channel, or "target" RF channel. The output of NCO **310(1)** is multiplied by all the RF channels received at complex multiplier **320(1)**. When an multi-channel RF signal is multiplied with the output of NCO **310(1)**, the frequency of target RF channel signal is shifted to a desired channel. In some embodiments of the present invention, the target RF channel is shifted to a baseband, i.e., centered at DC. LPFs **330(1** . . . n) receive all RF channels and each filters out all RF channels except for its target RF channel. Thus, only the target RF channel passes. Accordingly, separate RF channels exit digital tuner **300**, i.e., the multi-channel RF signal is demultiplexed. Digital tuner circuit **300** then outputs the separated RF channels C_1 to C_n, each RF channel being centered at baseband.

('866 Pet, pp. 22-25; Ex. 1002 (Lett '866 Dec.), ¶¶ 108-112; Ex. 1013 (Zhang), ¶ [0032], Figs. 3, 5)

Zhang's Parallel Multiplier-Filter Circuits and Signal Paths Operate "concurrently"

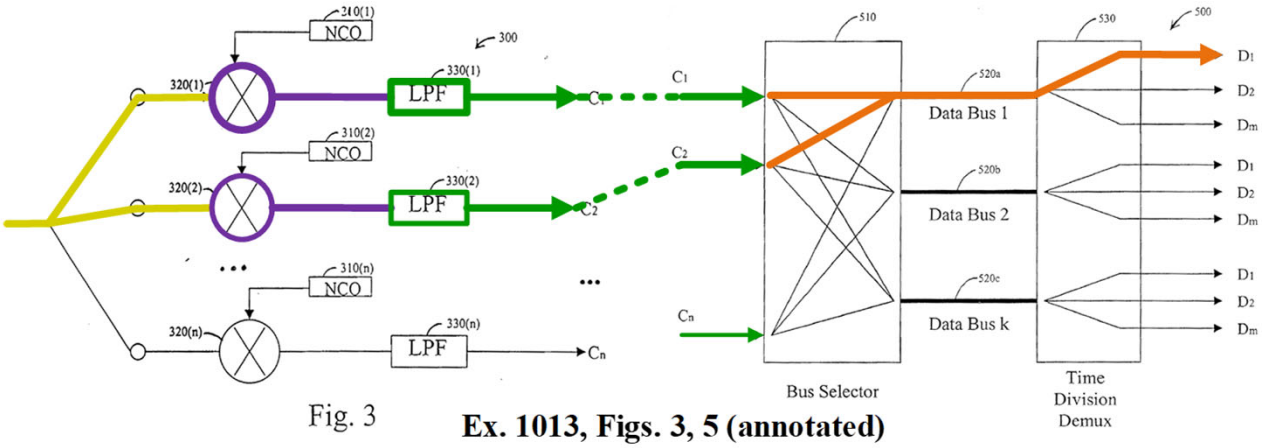


Fig. 3

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

Petitioner's Expert Petition Declaration, ¶¶ 110-111

34, 36-37 *with* Ex. 1001, Fig. 2 (filters 260), 6:3-8. Like the '866 patent's digital front end, each path includes a complex multiplier 320 (**purple**) followed by a FIR low pass filter (LPF) 330 (**green**).

111. Each separate path receives the multi-channel RF signal from ADC 220 and operates concurrently and in a similar way to select one desired channel. Ex. 1013, [0031] ("In operation, digital tuner 300 receives the RF channels from an ADC, such as ADC 220 of FIG. 2, and then separates the RF channels C_1 to C_n, which are in the digital domain."). In each path, complex multiplier 320 first shifts

'866 Patent, Element [1C]: "digital front end … configured to

concurrently select and provide each of a plurality of desired channels,

via a serial interface,

without providing any of the plurality of undesired channels"

Petitioner's Expert Reply Declaration, ¶31

31. My second point was that, even with the signal propagation delay, in Zhang and in the '866 patent the desired channels are data streams, meaning that they include a time sequence of data. I pictorially showed this in my previous declaration as the channels passing through the serial interface. Ex. 1002, ¶¶ 131-132. As I described during my deposition, when a channel is first selected, there is a time lapse to when the channel starts streaming from the output. However, after that, the channel continues to stream and, thus, it is concurrently being selected and provided. Ex. 2019, 78:16-25, 81:4-11. That is, some data in the channel's data stream is received at the input of Zhang's demultiplexer 230 concurrently with other data in the stream output from the serial interface of selector 240. To the extent that Element [1C] requires "selecting" to be concurrent with "providing," Zhang discloses it.

('866 Pet, pp. 22-25; Ex. 1002 (Lett '866 Dec.), ¶¶ 108-112; '866 Reply, p. 25; Ex. 1078 (Lett '866 Reply Dec.), ¶ 31; Ex. 1013 (Zhang), Figs. 3, 5)

Zhang's Selector Teaches "via a serial interface"

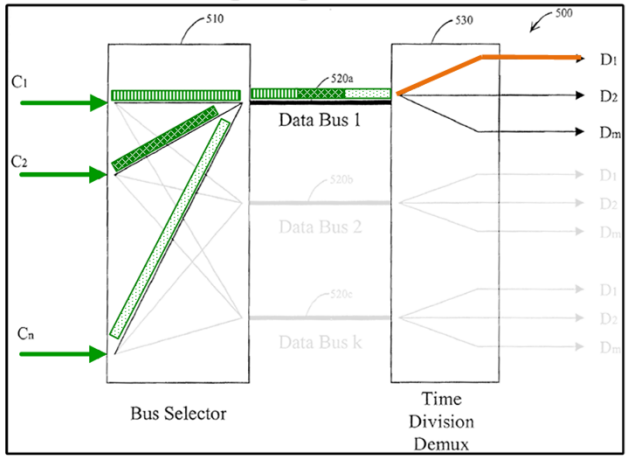
Element [1C]: "digital front end … configured to

concurrently select and provide each of a plurality of desired channels,

via a serial interface,

without providing any of the plurality of undesired channels"

Zhang, Fig. 5, (annotated)



'866 Petition, p. 25

> Selector 240 with "one" bus (e.g., Data bus 1) receives channels C_1-C_n from demultiplexer 230 (represented by green blocks with different patterns) and sends them across the bus "with the use of time division multiplexing." *Id.*; Ex. 1016, pp. 79-80, Figs. 6-25; Ex. 1002, ¶ 113.

> A POSITA would have understood that this sends different channels sequentially (serially) in different time divisions over a single data path as shown, and that such a path is a "serial interface" as claimed in Element [1C]. Ex. 1013,

('866 Pet, pp. 24-28; Ex. 1002 (Lett '866 Dec.), ¶¶ 113-120; Ex. 1013 (Zhang), Fig. 5)

Zhang Desired Channels D1-Dm (All or a Subset of C1-Cn) are Provided Without Undesired Channels

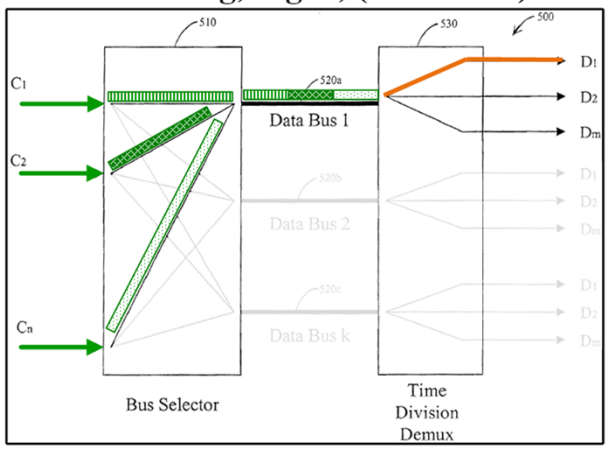
Element [1C]: "digital front end … configured to

concurrently select and provide each of a plurality of desired channels,

via a serial interface,

without providing any of the plurality of undesired channels"

Zhang, Fig. 5, (annotated)



- Patent Owner's Expert agrees that D1-Dm are "desired channels"
- D1-Dm are provided without providing undesired channels

Patent Owner's Expert Declaration, Ex. 2009, ¶ 78

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

('866 Pet, pp. 22-25; Ex. 1002 (Lett '866 Dec.), ¶¶ 108-113; Ex. 1013 (Zhang), Fig. 5; '866 PO Resp., pp. 32-33; Ex. 2009 ('866 Russ Dec.), ¶ 78)

Zhang Discloses the '866 Patent's Elements [14C] and [14D]

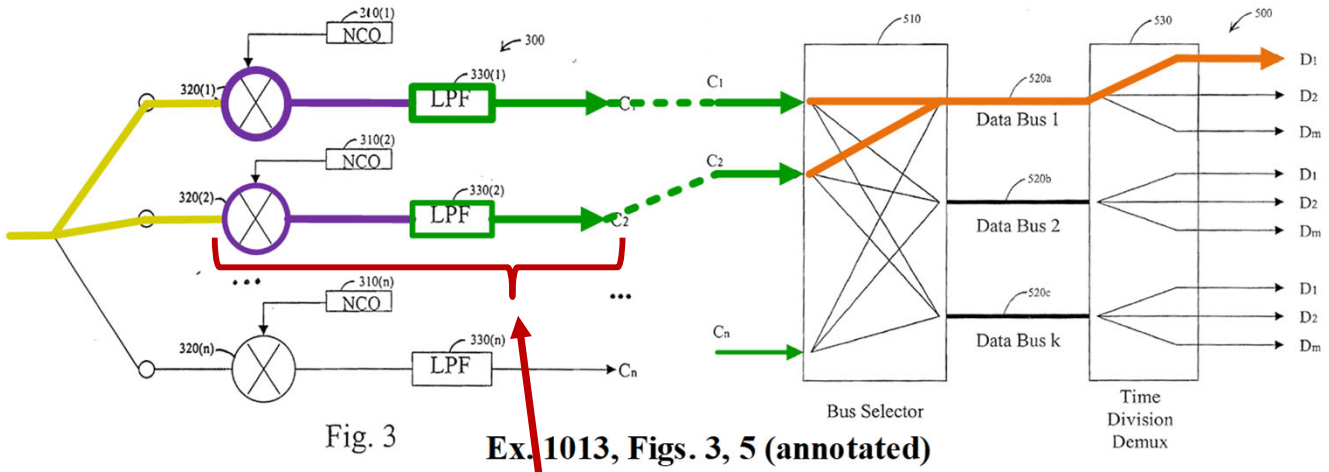


Fig. 3

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

Element [14C]:

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

Element [14D]

wherein the plurality of digital down converters is operable to provide each digital channel output via a serial interface.'"

('866 Pet., pp. 28-32; Ex. 1002 (Lett '866 Dec.), ¶¶ 125-132; Ex. 1013 (Zhang), Figs. 3, 5; '866 Reply, pp. 18-19, 21; Ex. 1078 (Lett '866 Reply Dec.), ¶¶ 22-23)

The ’206 Patent
Elements [1D]-[1E] and [13D]-[13E]

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

[1E] providing the plurality of desired channels via a serial interface.

Elements 25D-25E and 51D-51E include the same disputed limitation as elements 1D-1E (except for the “serial interface”).

[13D] digitally down converting each desired channel, of the plurality of desired channels, to generate a plurality of digital channel outputs; and

[13E] providing the plurality of digital channel outputs via a serial interface

Elements 38D and 64D include the same disputed limitation as element 13D.

Zhang Discloses the '206 Patent's Disputed Limitations When All or a Subset of the Multiplier-Filter Circuits are Connected to D1-Dm

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

[1E] providing the plurality of desired channels via a serial interface.

All "C" Channels Selected

A Subset of "C" Channels Selected

Zhang, Fig. 3, (annotated)

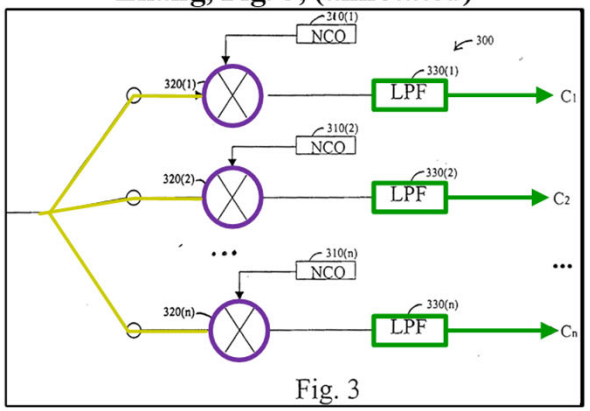
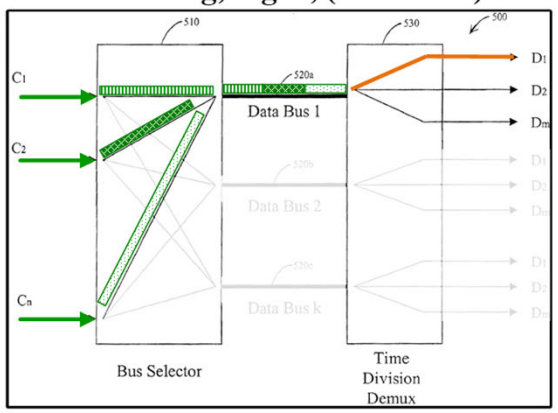


Fig. 3

Zhang, Fig. 5, (annotated)



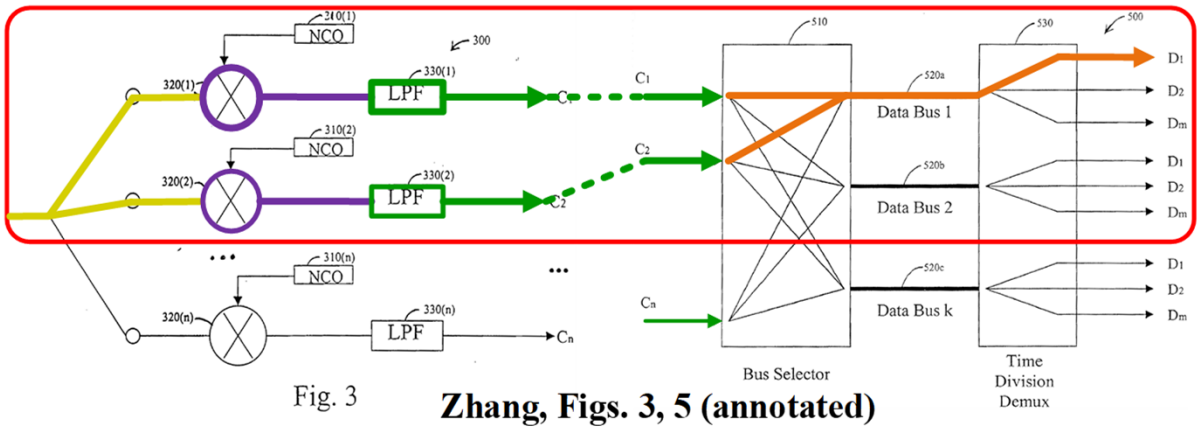


Fig. 3

Zhang, Figs. 3, 5 (annotated)

('206 Pet., pp. 23-29; Ex. 1002 (Lett '206 Decl.), ¶¶ 109-121; Ex. 1013 (Zhang), Figs. 3, 5)

Zhang's D1-Dm are selected "from the input signal" Just Like the Desired Channels in Figure 2 in the '206 Patent

'206 Patent, Claim 1

1. A method for receiving a television (TV) signal comprising:

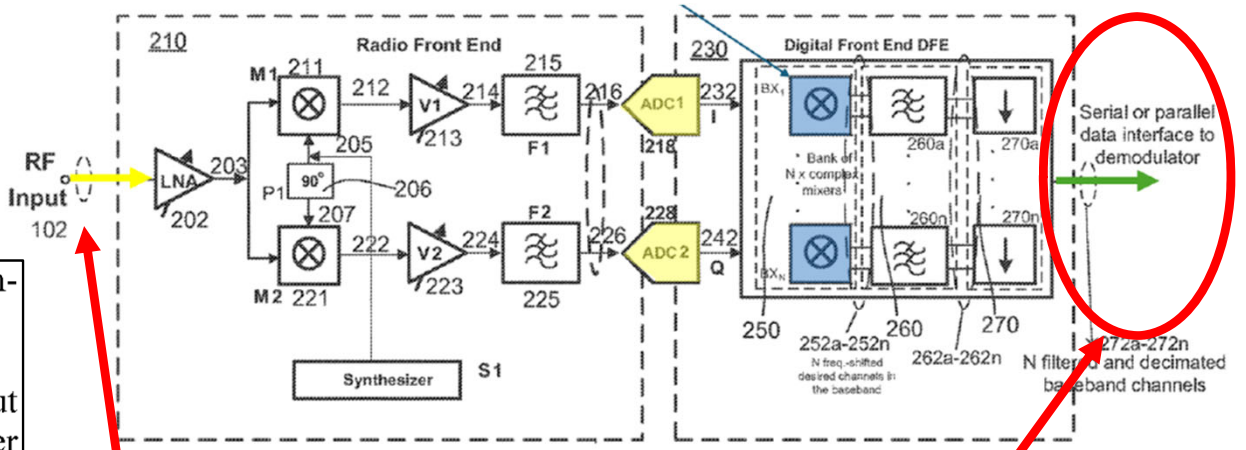
receiving an input signal from a cable network;

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

concurrently selecting each of the plurality of desired channels from the input signal without selecting any of the plurality of undesired channels; and

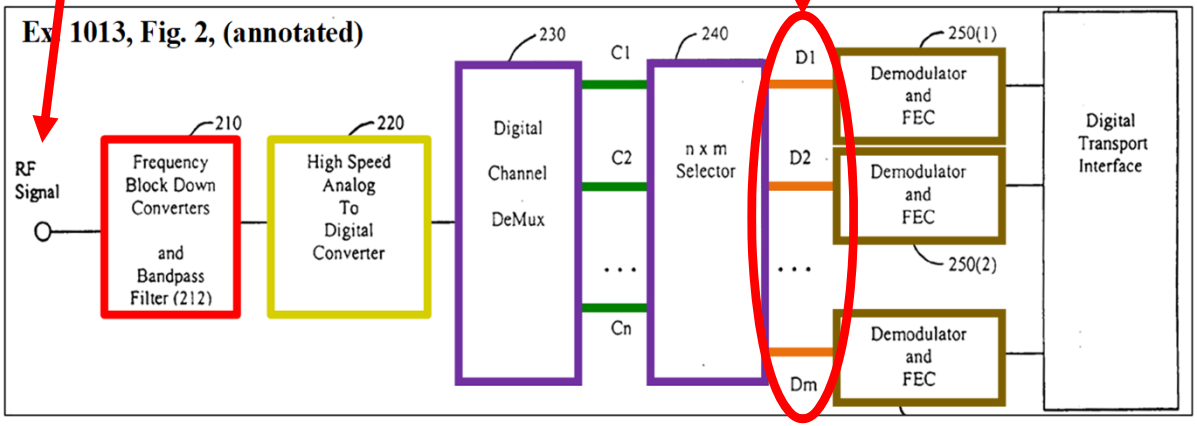
providing the plurality of desired channels via a serial interface.

'206 PO Resp., p. 4 (citing '206 Patent, Fig. 2, annotated)



Input Signal

Desired Channels Selected from the Input Signal



'206 Pet. Reply, p. 9 (citing Zhang, Ex. 1013, Fig. 2, annotated)

('206 Pet. Reply, pp. 8-14;
Ex. 1078 ('206 IPR, Lett Reply Dec.), ¶¶ 5-7, 30-31)

Zhang's C1-Cn or D1-Dm are the "digital channel outputs"

[13D] digitally down converting each desired channel, of the plurality of desired channels, to generate a plurality of digital channel outputs; and [13E] providing the plurality of digital channel outputs via a serial interface.

All "C" Channels Selected

A Subset of "C" Channels Selected

Zhang, Fig. 3, (annotated)

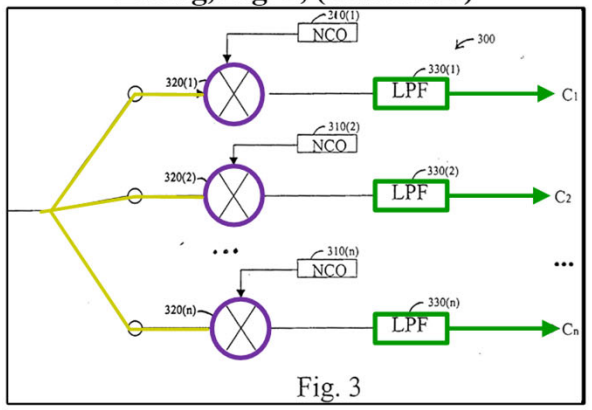
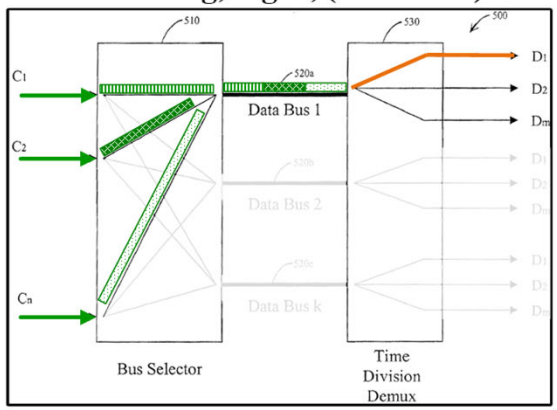


Fig. 3

Zhang, Fig. 5, (annotated)



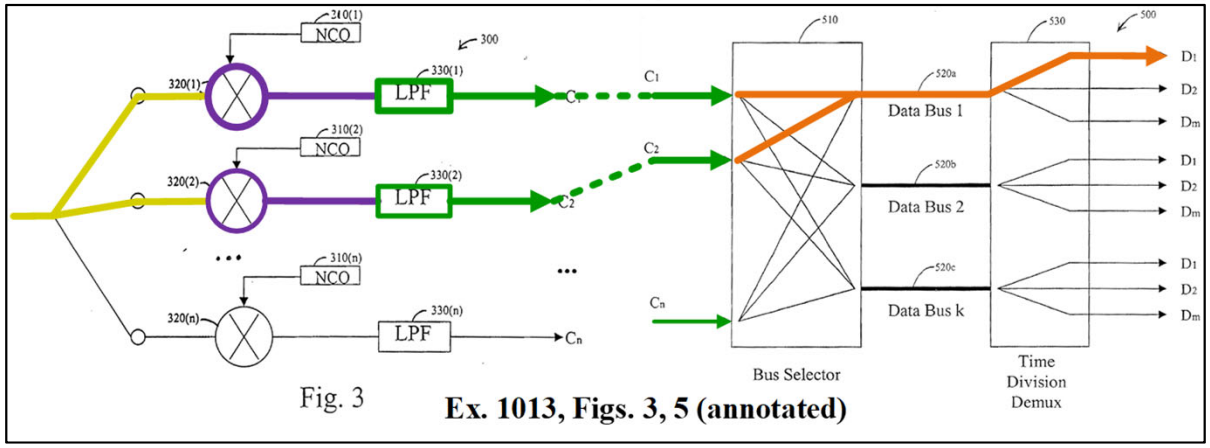


Fig. 3

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

Does not exclude down converting undesired channels

('206 Reply, pp. 21-26)

Zhang's C1-Cn or D1-Dm (which are all or a subset of C1-Cn) are generated by "digitally down converting each desired channel" and "provid[ed]…via a serial interface."

('206 Pet., pp. 30-33; Ex. 1002 (Lett 206 Dec.), ¶¶ 129-136; Ex. 1013, Figs. 3, 5)

Remaining Combinations Which are Not Disputed

’362 IPR Prior Art

- **Zhang** (Ex. 1013)
  - Ind. Claims 1, 11- Standard RF receiver architecture with a contiguous band of desired and undesired channels at the input
  - Claims 2-3, 12-13 – Serial and Parallel Interfaces
  - Claims 8-9, 18-19 – Finite Impulse Response Filters in the Digital Down Converters
- **Mirabbasi** (Ex. 1018)
  - MPF structure for digital circuitry in claim 1
  - Claims 4-6, 14-16 – using in-phase and quadrature structures for analog mixer module, ADCs, and digital mixers
- **Pandey** (Ex. 1014)
  - Claims 2-3, 12-13 – communicating data with serial and parallel interfaces
- **Karabinis** (Ex. 1020)
  - Claims 7, 17 – shifting desired channels into a contiguous frequency spectrum
- **Jensen** (Ex. 1026)
  - Claims 10, 20 – including a decimator to reduce digital data

(’362 Pet., pp. 8-18; Ex. 1002 (Lett ’362 Dec.), ¶¶ 78-95)

’866 IPR Prior Art

- **Zhang** (Ex. 1013)
  - Ind. Claims 1, 13-14, 26-27, 40-41, 54-55, 68-69, 82- Standard RF receiver architecture with a contiguous band of desired and undesired channels at the input
  - Claims 1, 14, 35-36, 49-50, 63-64, 77-78 - Serial and parallel interfaces
  - Claims 3-6, 16-19, 29-32, 43-46, 57-60, 71-74 - in-phase and quadrature components of the RF receiver
  - Claims 7, 20, 33, 47, 61, 75 - Demodulating desired channels
  - Claims 9-10, 22-23, 37-38, 51-52, 65-66, 79-80- Cable Broadcast Network, DOCSIS
- **Reisman** (Ex. 1052)
  - Claims 9-12, 22-25, 27, 37-39, 41, 51-53, 55, 65-67, 69, 79-81- DVR, Picture-in-picture, cable broadcast channel, DOCSIS
- **Jackson** (Ex. 1057)
  - Claims 2-6, 15-19, 28-31, 42-46, 56-59, 70-74 –cable network connector, analog amplifier and filter, in-phase and quadrature components of RF receiver,
- **Pandey** (Ex. 1014)
  - Claims 1, 8, 14, 21, 34-36, 48-50, 62-64, 76-78 - Serial and parallel interfaces

(’866 Pet., pp 4-14; Ex. 1002 (Lett ’866 Dec.), ¶¶ 77-90)

’206 IPR Prior Art

- **Zhang** (Ex. 1013)
  - Ind. Claims 1, 13, 25, 38, 51, 64 - Standard RF receiver architecture with a contiguous band of desired and undesired channels at the input
  - Claims 1, 13, 33-34, 46-47, 59-60, 72-73 - Serial and parallel interfaces
  - Claims 3-6, 15-18, 27-30, 40-43, 53-56, 66-69 - in-phase and quadrature components of RF receiver
  - Claims 7, 19, 31, 44, 57, 70 - Demodulating desired channels
  - Claims 9-10, 21-22, 35-36, 48-49, 61-62, 74-75 - Cable Broadcast Network, DOCSIS
- **Reisman** (Ex. 1052)
  - Claims 9-12, 21-25, 35-38, 48-51, 61-64, 74-76 - DVR, Picture-in-picture, cable broadcast channel, DOCSIS
- **Jackson** (Ex. 1057)
  - Claims 2-6, 14-18, 26-30, 39-43, 52-56, 65-69–cable network connector, analog amplifier and filter, in-phase and quadrature components of RF receiver,
- **Pandey** (Ex. 1014)
  - Claims 1, 8, 13, 20, 32-34, 45-47, 58-60, 71-73- Serial and parallel interfaces

’206 Pet., pp. 5-15; Ex. 1002 (Lett ’206 Dec.), ¶ 74-87

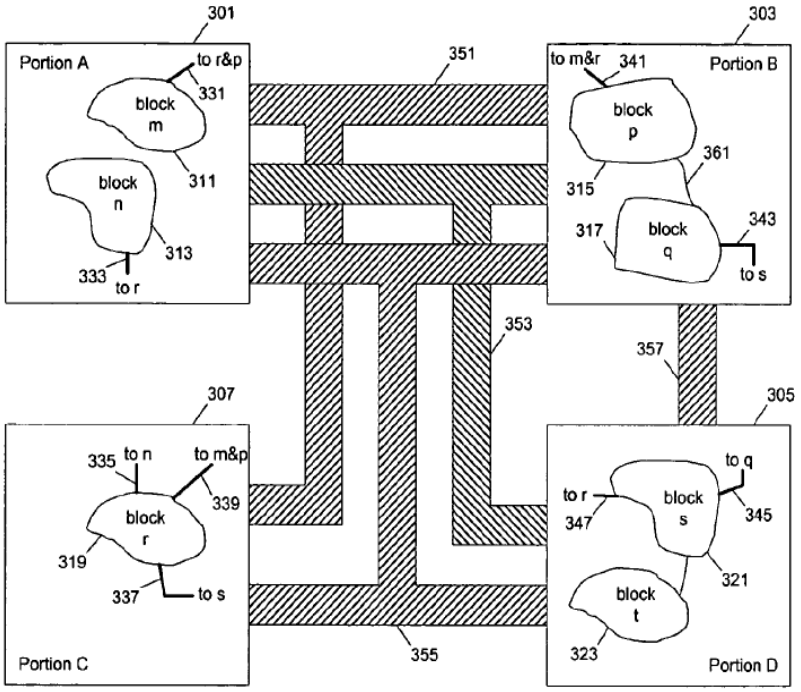
Pandey (U.S. Pat. No. 7,237,214)

- Pandey teaches creating specific **serial** and **parallel** interfaces using a computer aided technique for implementing a digital circuit design (e.g., such as Zhang's digital circuitry) on a FPGA or ASIC chip.

(Ex. 1014 (Pandey), Abstract, 1:15-55, 2:4-12;
'362 Pet., p. 43-44; Ex. 1002 (Lett '362 Dec.), ¶¶ 159-160;
'866 Pet., p. 72; Ex. 1002 (Lett '866 Dec.), ¶252;
'206 Pet., p. 69; Ex. 1002 (Lett '206 Dec.), ¶239)

- Depending upon the partitioning of the circuit design within finite area and finite interconnection of a chip, Pandey's optimization will in some layouts result in signals being grouped and time multiplexed through a **serial interface** between partitions, and in other layouts result in signals having individual dedicated traces with no multiplexing, which is a **parallel interface**.

(Ex. 1014 (Pandey), 31:20-22, 32:12-15;
'362 Pet., pp. 44-47; Ex. 1002 (Lett '362 Dec.), ¶161-164;
'866 Pet., p. 74; Ex. 1002 (Lett '866 Dec.), ¶255;
'206 Pet., pp. 71-72; Ex. 1002 (Lett '206 Dec.), ¶241)



('362 Pet., p. 44;
'866 Pet., p. 73;
'206 Pet., p. 70;
Ex. 1014 (Pandey), Fig. 3)

Zhang-Pandey (’362/’866/’206 IPRs)

- It would have been obvious to apply Pandey’s optimization for dedicated (i.e., **parallel**) and time-multiplexed (i.e., **serial**) interconnection to the interconnection between Zhang’s demultiplexer 230, digital selector 240, and/or demodulators 250 because Zhang teaches optimizing the real estate needed for implementing the digital portion of its system on a single chip, and the process described in Pandey would have been beneficial in this implementation.

(Ex. 1013 (Zhang), [0029], [0037], [0044], [0047]-[0048];
Ex. 1014 (Pandey), 1:20-2:12, 6:10-15;
’362 Pet., pp. 46-47; Ex. 1002 (Lett ’362 Dec.), ¶¶ 163-164;
’866 Pet., pp. 75-76; Ex. 1002 (Lett ’866 Dec.), ¶¶ 256-257;
’206 Pet., pp. 72-73; Ex. 1002 (Lett ’206 Dec.), ¶¶ 242-243)

- Zhang-Pandey teaches “via a serial interface” or “via a parallel interface” feature recited in the following claims:

Patent	Claims
’362	2, 3, 12, 13
’866	1, 8, 14, 21, 34-36, 48-50, 62-64, 76-78
’206	1, 8, 13, 20, 32-34, 45-47, 58-60, 71-73

Undisputed

(’362 Pet., pp. 43-47; ’866 Pet., pp. 72-78; ’206 Pet., pp. 69-75)

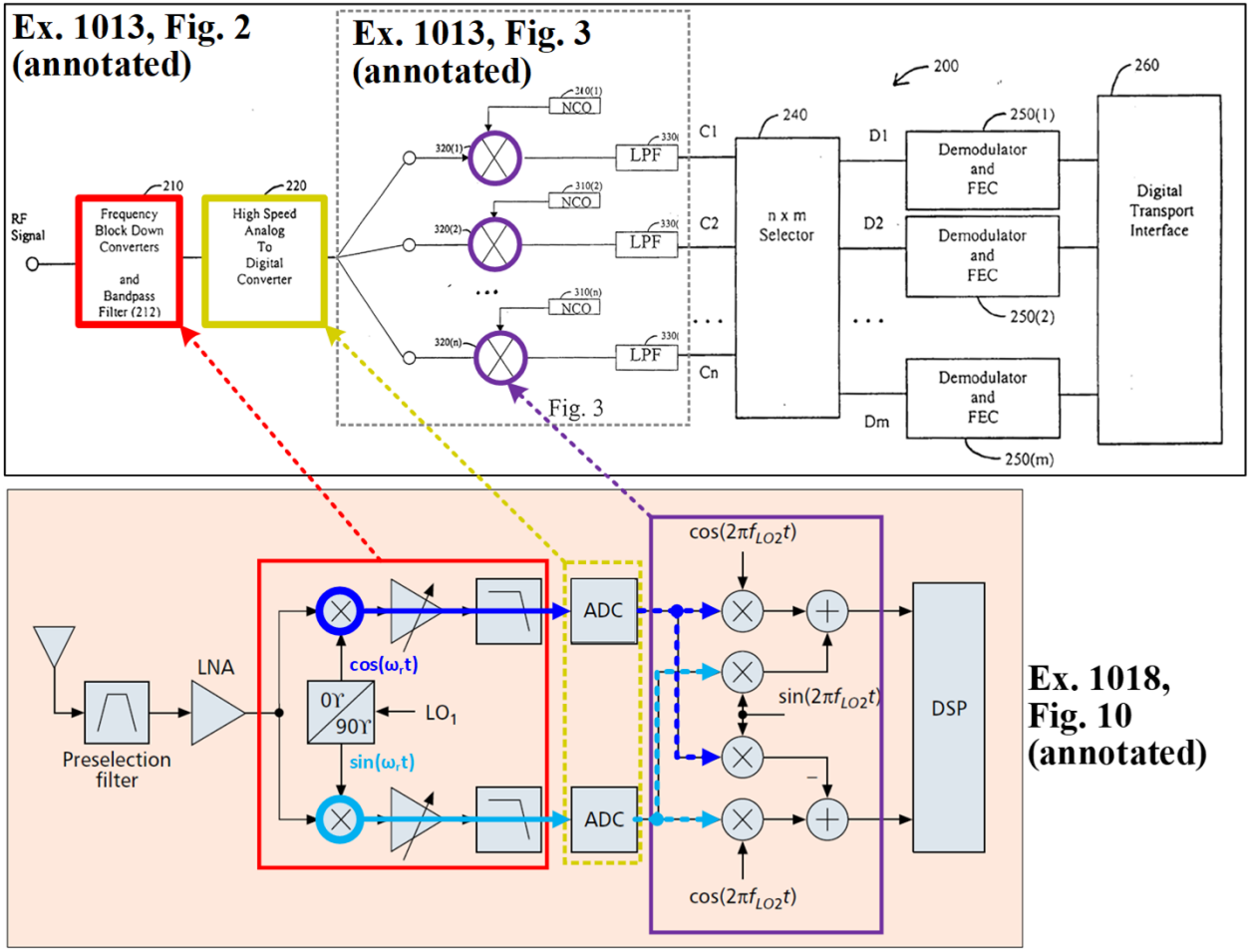
Mirabbasi ("Classical and Modern Receiver Architectures")

- Mirabbasi's **RF analog frontend** includes a **first mixer** and a **second mixer** that generate in-phase and quadrature signals.

(Ex. 1018 (Mirabbasi), pp. 5-6, Fig. 2; '362 Pet., pp. 49-50; Ex. 1002 (Lett '362 Dec.), ¶¶ 170-171)

- Mirabbasi's "Low-IF Receiver" has the same architecture as that in Zhang, which includes a **RF analog frontend** that performs frequency downconversion of the analog input to an intermediate frequency (IF), followed by an **analog-to-digital converter** that digitizes the analog IF signal, followed by a **digital multiplexer** that further downconverts the digitized signal to a baseband signal, which is then processed by additional digital circuitry to demodulate the signal and recover the modulated data.

(Ex. 1018 (Mirabbasi), pp. 9-10, Fig. 10; '362 Pet., pp. 50-51; Ex. 1002 (Lett '362 Dec.), ¶ 170)



(Ex. 1013 (Zhang), Figs 2-3; Ex. 1018 (Mirabbasi), Fig. 10; '362 Pet., p. 49; Ex. 1002 (Lett '362 Dec.), ¶170)

Zhang-Mirabbasi (only ’362 IPR)

- A POSITA would have been motivated to use Mirabbasi’s low-IF design—i.e., it’s analog complex mixer including first and second mixers, pair of ADCs, and its complex mixer—to implement Zhang’s corresponding receiver components because of the advantages of Mirabbasi’s low-IF receiver, including eliminating DC offset in the baseband signals, making the sampling of the IF signal with ADCs more feasible because the IF signal is at a lower frequency, and eliminating gain and phase mismatches between the in-phase and quadrature signals because they are partially downconverted and corrected digitally.

(Ex. 1018 (Mirabbasi), pp. 8-10;
’362 Pet., p. 51-53; Ex. 1002 (Lett ’362 Dec.), ¶¶ 185-188)

- Zhang-Mirabbasi is relied on for any claims that recite (or possibly include) features related to separating the input RF signal into in-phase and quadrature signals for subsequent processing (e.g., claim 1’s “digital circuitry” if construed as means-plus-function, “in-phase signal” and “quadrature signal” in claims 4-5, and “complex mixers” in claim 6) and thus is relied on for the following claims:

Patent	Claims
’362	1-6, 8-9, 14-16

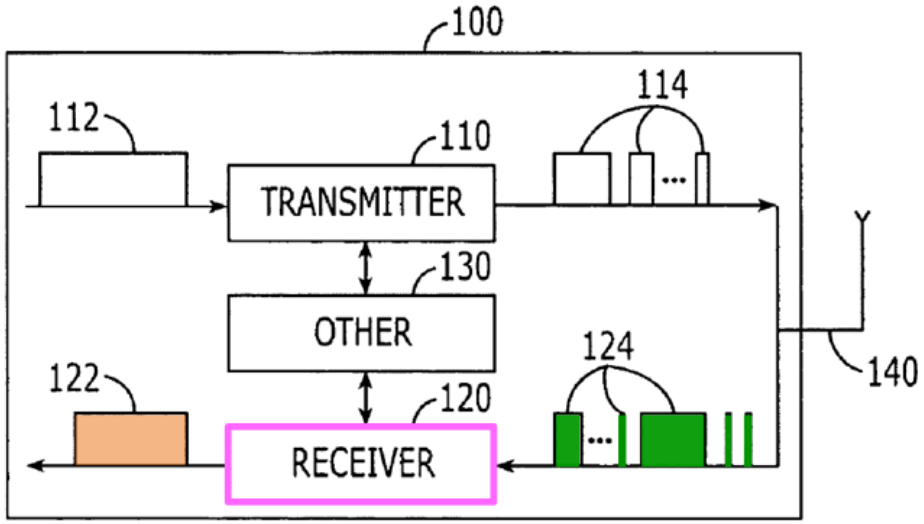
Undisputed

(’362 Pet., pp. 48-60, 74-76; Ex. 1002 (Lett ’362 Dec.), ¶¶ 167-190, 215-221)

Karabinis (U.S. Pub. No. 2006/0233147)

- Karabinis teaches a **receiver 120** receives a **plurality of signals with non-contiguous frequencies**, and translates the frequencies so that the signals are output within a **contiguous frequency band**.

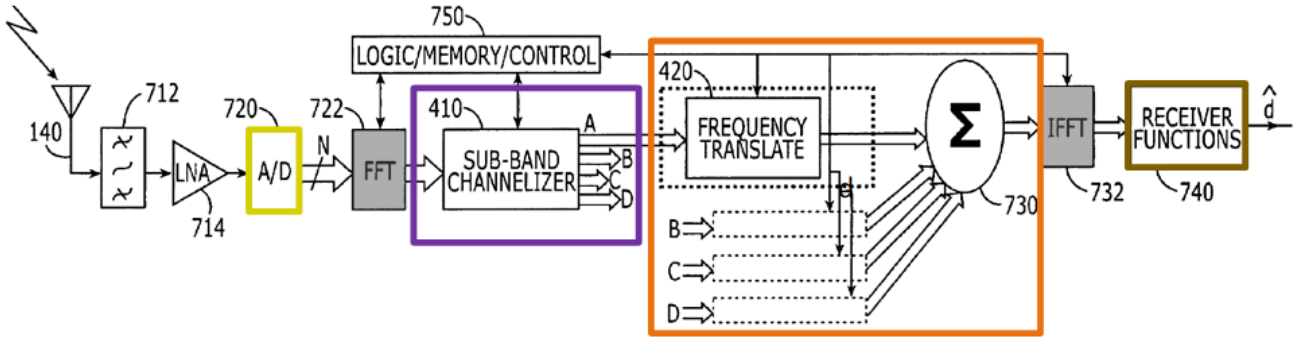
(Ex. 1020 (Karabinis), [0017], [0038], [0042]; '362 Pet., p. 63-66; Ex. 1002 (Lett '362 Dec.), ¶¶ 195-197)



(Ex. 1020 (Karabinis), Fig. 1; '362 Pet., p. 63; Ex. 1002 (Lett '362 Dec.), ¶195)

- Karabinis' **sub-band channelizer 410** isolates the non-contiguous frequency bands, and the **frequency translator 420** translates the isolated bands into one contiguous frequency band.

(Ex. 1020 (Karabinis), [0017], [0047]-[0049]; '362 Pet., pp. 64-66; Ex. 1002 (Lett '362 Dec.), ¶¶ 196-197)



(Ex. 1020 (Karabinis), Fig. 7; '362 Pet., pp. 63-64; Ex. 1002 (Lett '362 Dec.), ¶ 197)

Zhang-Mirabbasi-Karabinis (only ’362 IPR)

- A POSITA implementing Zhang-Mirabbasi’s receiver would have considered it obvious to modify the design according to Karabinis to output the desired channels in a contiguous frequency spectrum because this was another known option for providing the channels for demodulation. Doing so would have permitted a demodulator to receive all of the desired channels simultaneously over a single bus, which would have beneficially eliminated the need of having Zhang’s multiple data buses and time division demultiplexer between the buses and the demodulator.

(’362 Pet., pp. 66-67; Ex. 1002 (Lett ’362 Dec.), ¶201)

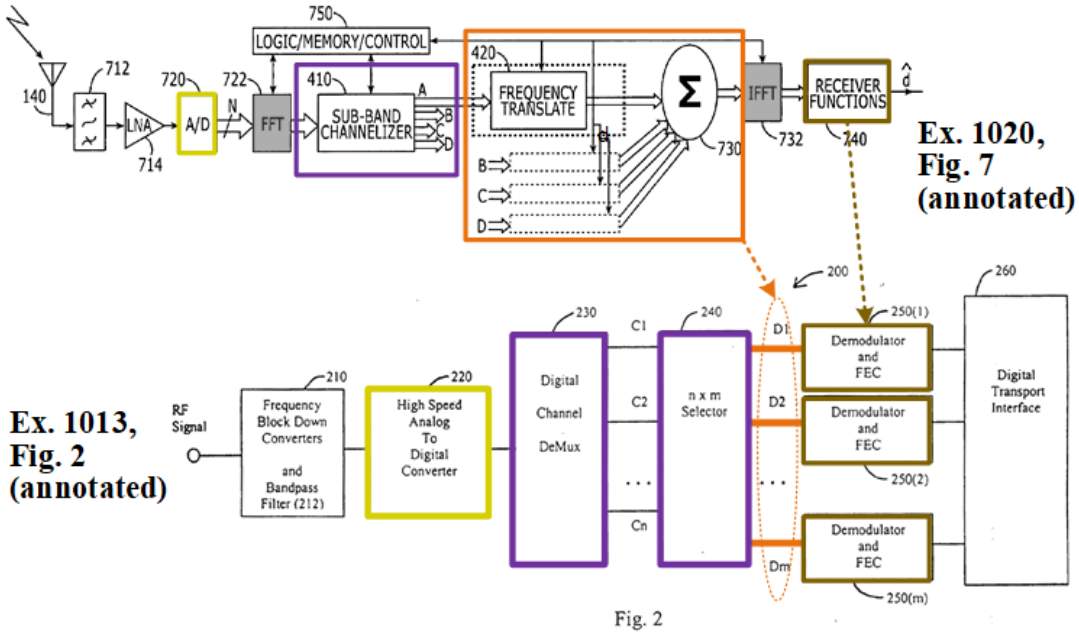


Fig. 2

(Ex. 1020 (Karabinis), Fig. 7; Ex. 1013 (Zhang), Fig. 2; ’362 Pet., p. 64; Ex. 1002 (Lett ’362 Dec.), ¶196)

- Zhang-Mirabbasi-Karabinis is relied on for feature of frequency shifting such that “after said frequency shift, said selected plurality of desired television channels occupy a contiguous frequency spectrum” recited in the following claims:

Patent	Claims
’362	7, 17

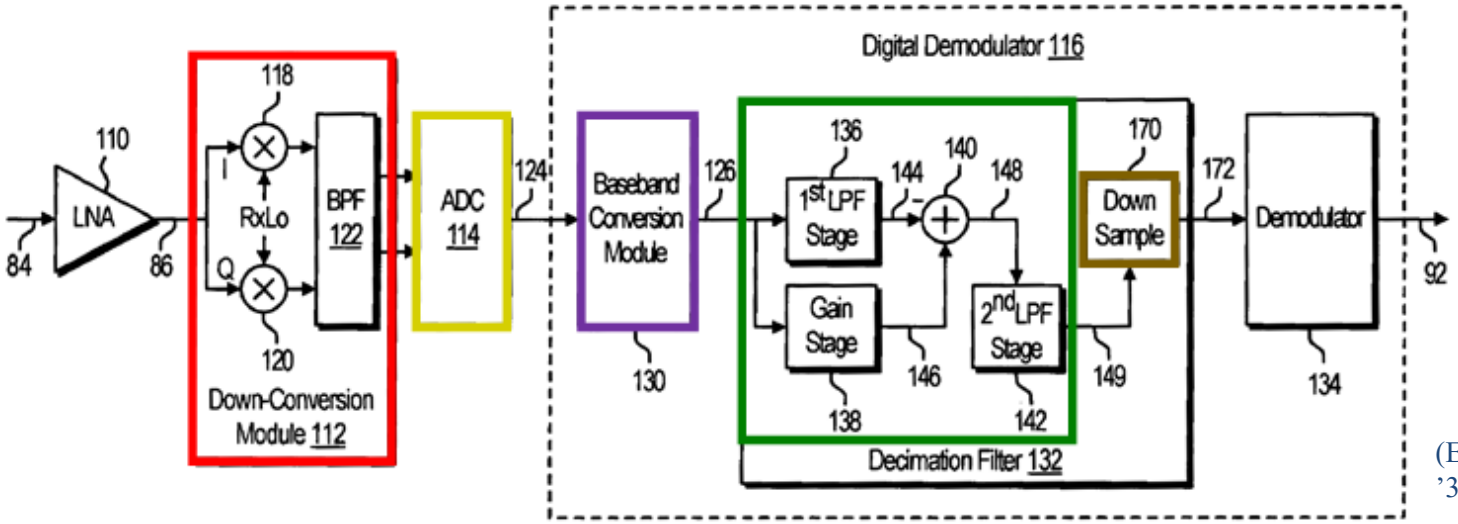
(’362 Pet., pp. 60-68; Ex. 1002 (Lett ’362 Dec.), ¶¶ 191-204)

Undisputed

Jensen (U.S. Pub. No. 2007/0027943)

- Jensen teaches that **decimation** was commonly performed to reduce a sampling rate of a digital signal.
- Reducing the sampling rate reduces the amount of data processed by the digital circuitry, which reduces power consumption and complexity in subsequent processing.
- Jensen discloses a similar receiver to that of Zhang, including having an analogous **down converter** to downconvert an RF signal to an IF signal, an **ADC** to convert the analog IF signal to a digital IF signal, a **baseband conversion module (i.e., mixer module)** to convert the digital IF signal to a baseband signal, and a **low pass channel select filter**.

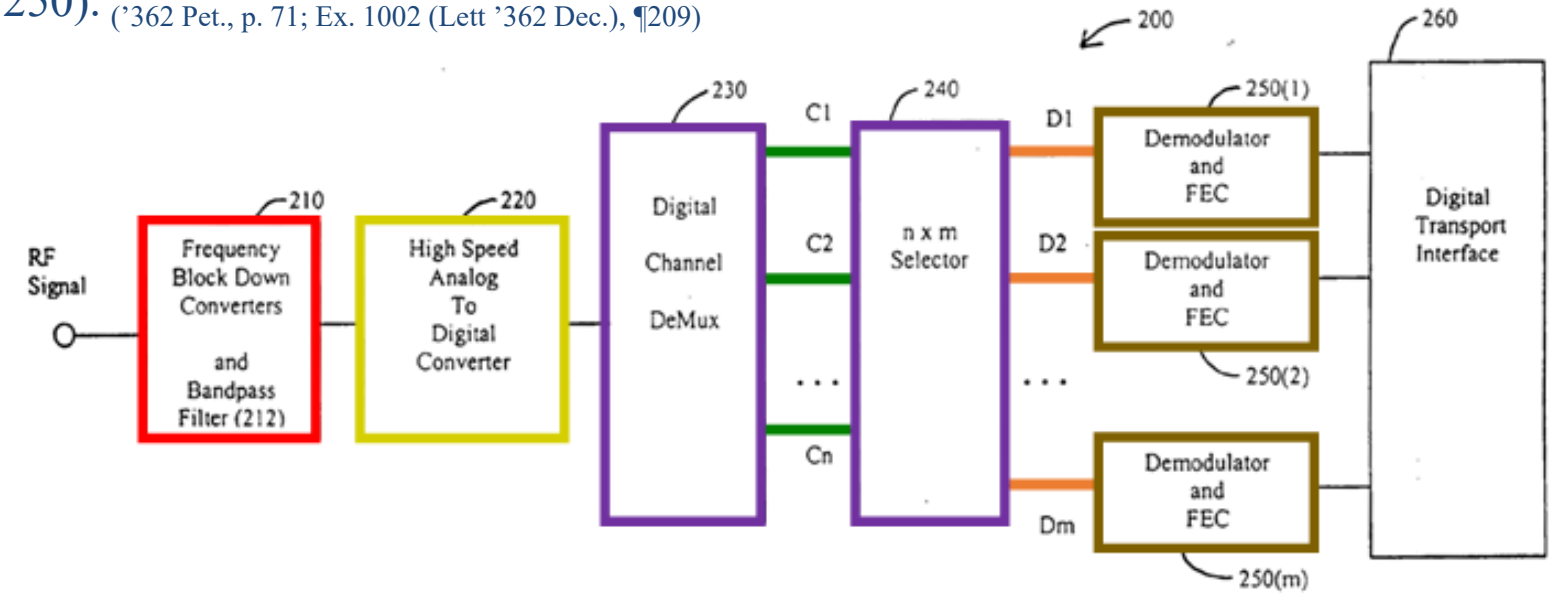
(Ex. 1026 (Jensen), [0007], [0027];
'362 Pet., pp. 69-70; Ex. 1002 (Lett '362 Dec.), ¶¶206-207)



(Ex. 1026 (Jensen), Fig. 1;
'362 Pet., p. 70; Ex. 1002 (Lett '362 Dec.), ¶206)

Zhang-Jensen (only ’362 IPR)

- A POSITA would have included a decimator circuit in Zhang’s **Channel Demultiplexer 230** or **Digital Selector 240**, either as a separate component following the low pass filters or as part of channel-select decimation filters used for the low pass filters, to reduce the sampling rate of digital signals and thereby reduce power consumption and/or complexity in subsequent processing (e.g., in demodulators 250). (’362 Pet., p. 71; Ex. 1002 (Lett ’362 Dec.), ¶209)



(Ex. 1013 (Zhang), Fig. 2; ’362 Pet., p. 8)

- Zhang-Jensen is relied on for the “decimation circuit” and “decimating” feature recited in the following claims:

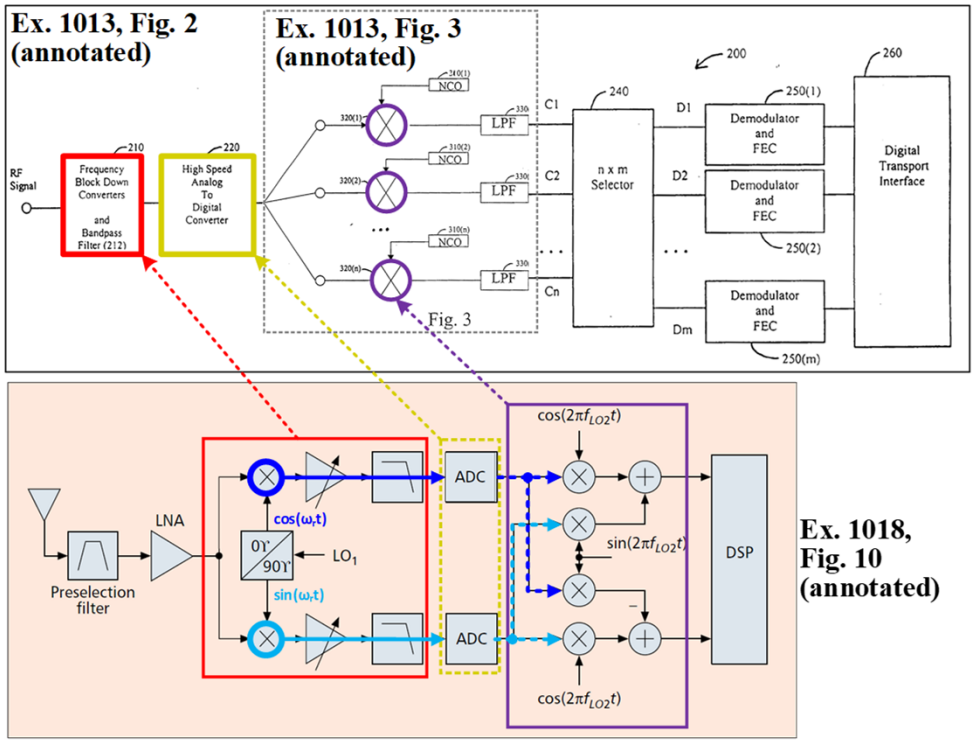
Patent	Claims
’362	10, 20

(’362 Pet., pp. 68-72; Ex. 1002 (Lett ’362 Dec.), ¶¶ 206-211)

Undisputed

Zhang-Mirabbasi-Pandey (only ’362 IPR)

- This ground is relied on to the extent “digital circuitry” of Element [1D] is construed to be a means-plus-function term.
- Zhang-Mirabbasi teaches the same or equivalent structure, with any differences being insubstantial (e.g., multiple parallel paths, each including a complex mixer followed by a low pass filter followed by serial and parallel interfaces as shown in Figures 2 and 3 of Zhang and Figure 2 of the ’362 patent).
- The features added for “digital circuitry” to Zhang from Mirabbasi are independent of the Pandey features (e.g., parallel and serial interfaces) added to Zhang. (’362 Pet., pp. 74-77; Ex. 1002 (Lett ’362 Dec.), ¶¶215-221)



(Ex. 1013 (Zhang), Figs 2-3; Ex. 1018 (Mirabbasi), Fig. 10; ’362 Pet., p. 75; Ex. 1002 (Lett ’362 Dec.), ¶¶ 216-217)

- Zhang-Mirabbasi-Pandey is relied on for claims that recite “via a serial interface” or “via a parallel interface” and if “digital circuitry” invokes means-plus-function:

Patent	Claims
’362	2, 3

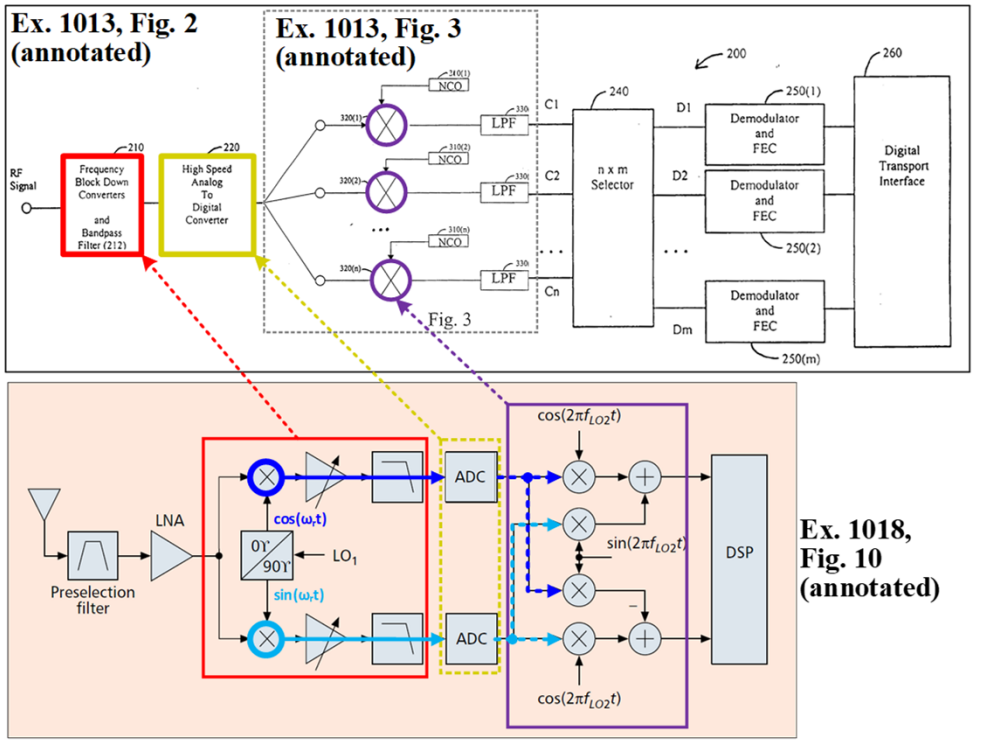
(’362 Pet., pp. 72-77; Ex. 1002 (Lett ’362 Dec.), ¶¶220-221)

Undisputed

Zhang-Mirabbasi-Jensen (only ’362 IPR)

- This ground is relied on to the extent “digital circuitry” of Element [1D] is construed to be a means-plus-function term.
- Zhang-Mirabbasi teaches the same or equivalent structure, with any differences being insubstantial (e.g., multiple parallel paths, each including a complex mixer followed by a low pass filter followed by serial and parallel interfaces as shown in Figures 2 and 3 of Zhang and Figure 2 of the ’362 patent).
- The features added for “digital circuitry” to Zhang from Mirabbasi are independent of the Jensen features (a decimator circuit) added to Zhang.

(’362 Pet., pp. 74-77; Ex. 1002 (Lett ’362 Dec.), ¶¶215-221)



(Ex. 1013 (Zhang), Figs 2-3; Ex. 1018 (Mirabbasi), Fig. 10; ’362 Pet., p. 75; Ex. 1002 (Lett ’362 Dec.), ¶¶ 216-217)

- Zhang-Mirabbasi-Jensen is relied on for claims that recite “a decimator circuit” and if “digital circuitry” invokes means-plus-function:

Patent	Claims
’362	10, 20

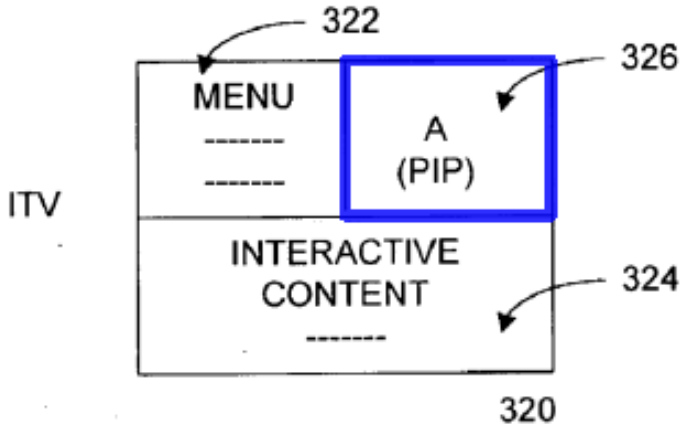
(’362 Pet., pp. 74-77; Ex. 1002 (Lett ’362 Dec.), ¶¶ 220-221)

Undisputed

Reisman (U.S. Pub. No. 2003/0229900)

- Reisman discloses TV systems that coordinate the viewing of traditional audiovisual content with hypermedia and interactive features.
- Reisman's systems include STBs with a digital video recorder (DVR) and **"picture-in-picture display" capabilities**.
- Reisman teaches broadcasting programs in a cable system.
- Reisman teaches that transmission protocols in a cable system include DOCSIS.

(Ex. 1052 (Reisman), Abstract, Figs. 1, 3, [0005], [0043], [0048], [0052], [0060], [0063], [0073], [0086]-[0088], [0090], [0098], [0118]-[0121], [0125], [0187], [0197], [0235], [0281]-[0285], [0291], [0296], [0534], [0537], [0546]; '866 Pet., pp. 7-8, 55-56; Ex. 1002 (Lett '866 Dec.), ¶¶82, 206, 211; '206 Pet., pp. 9, 51, 53; Ex. 1002 (Lett '206 Dec.), ¶¶79, 193, 198)



Ex. 1052, Fig. 3 (annotated)

(Ex. 1052 (Reisman), Fig. 3; '866 Pet., p. 8; Ex. 1002 (Lett '866 Dec.), ¶82; '206 Pet., p. 9; Ex. 1002 (Lett '206 Dec.), ¶79)

Zhang-Reisman (only ’866/’206 IPRs)

- A POSITA would have been motivated include Reisman’s DVR in Zhang’s STB to provide a more feature-filled and individualized user experience, which in the proposed combination still includes Zhang’s wideband front-end receiver components.
- A POSITA would have been motivated to include Reisman’s “picture-in-picture display” capability in Zhang’s STB, which in the proposed combination still has the wideband front-end receiver components, to allow a user to view different content simultaneously.
- It would have been obvious for Zhang to receive a cable broadcast channel as taught in Reisman for the benefit of broadening the channels Zhang’s STB provides.
- A POSITA would have been motivated to add to Zhang’s STB the ability to receive a desired channel via DOCSIS to allow desired channels to be addressed to a specific Zhang STB, which benefits the user by enabling enhanced features such as video-on-demand or other personalized content.

(’866 Pet., pp. 50, 52, 55, 56-57; Ex. 1002 (Lett ’866 Dec.), ¶¶190, 196, 207, 212; ’206 Pet., pp. 46, 48, 52, 53; Ex. 1002 (Lett ’206 Dec.), ¶¶178, 184, 194, 199)

- Zhang-Reisman teaches “a DVR,” “picture-in-picture display,” “cable broadcast channel,” and “DOCSIS” features recited in the following claims:

Patent	Claims
’866	9-12, 22-25, 27, 29-33, 35-40, 41, 43-47, 49-54, 55, 57-61, 63-68, 69, 71-75, 77-82
’206	9-12, 21-24, 25, 27-31, 33-37, 38, 40-44, 46-50, 51, 53-57, 59-63, 64, 66-70, 72-76

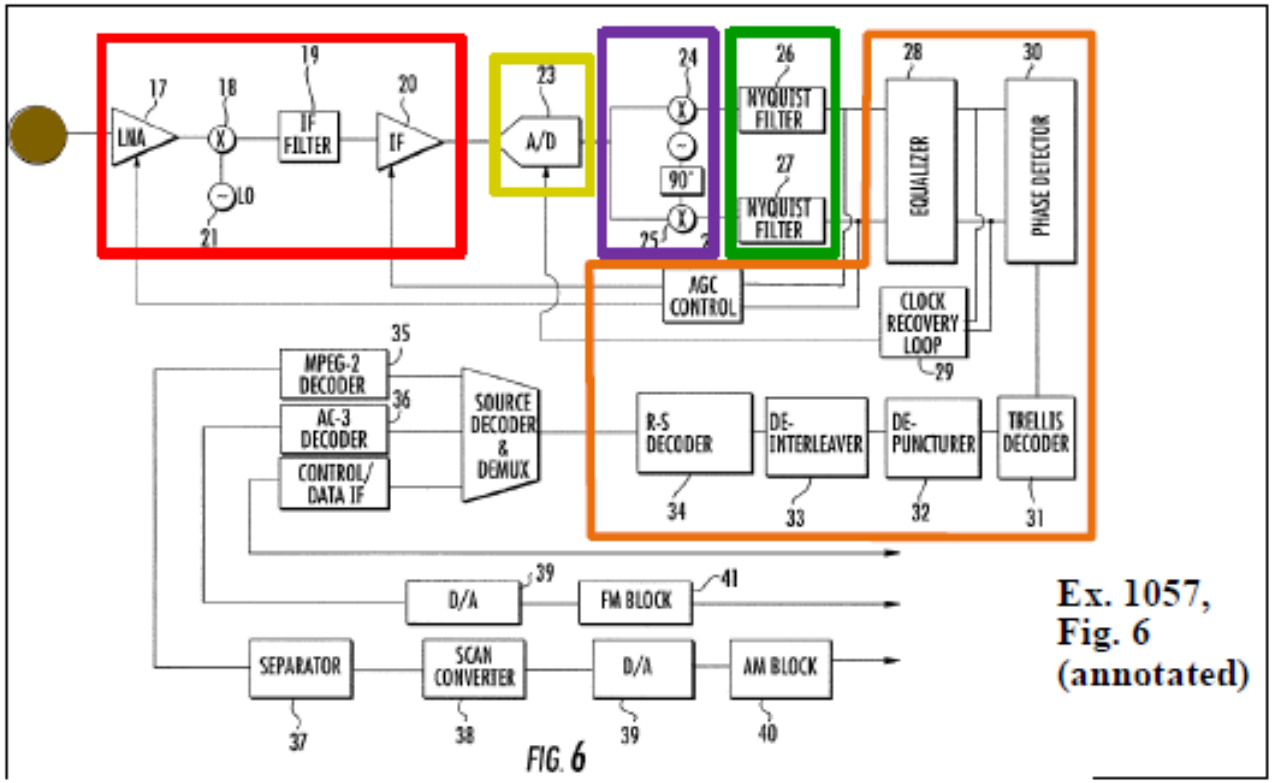
Undisputed

(’866 Pet., pp. 49-59; ’206 Pet., pp. 45-56)

Jackson (U.S. Pub. No. 2009/0113504)

- Jackson discloses a receiver system (similar to that of the '866 patent) for demodulating digital cable (TV) channels.
- The system includes a **cable network connector**, an **RF tuner front end** with analog amplifiers and filters, an **ADC**, a **complex mixer** that outputs in-band (I) and quadrature components (Q), **filters**, and a **demodulator**.

(Ex. 1057 (Jackson), [0001]-[0002], [0023]-[0027], Figs. 4b, 5-6, claims 1, 8, 12;
'866 Pet., pp. 8-9; Ex. 1002 (Lett '866 Dec.), ¶85;
'206 Pet., pp. 9-10; Ex. 1002 (Lett '206 Dec.), ¶82)



Ex. 1057, Fig. 6 (annotated)

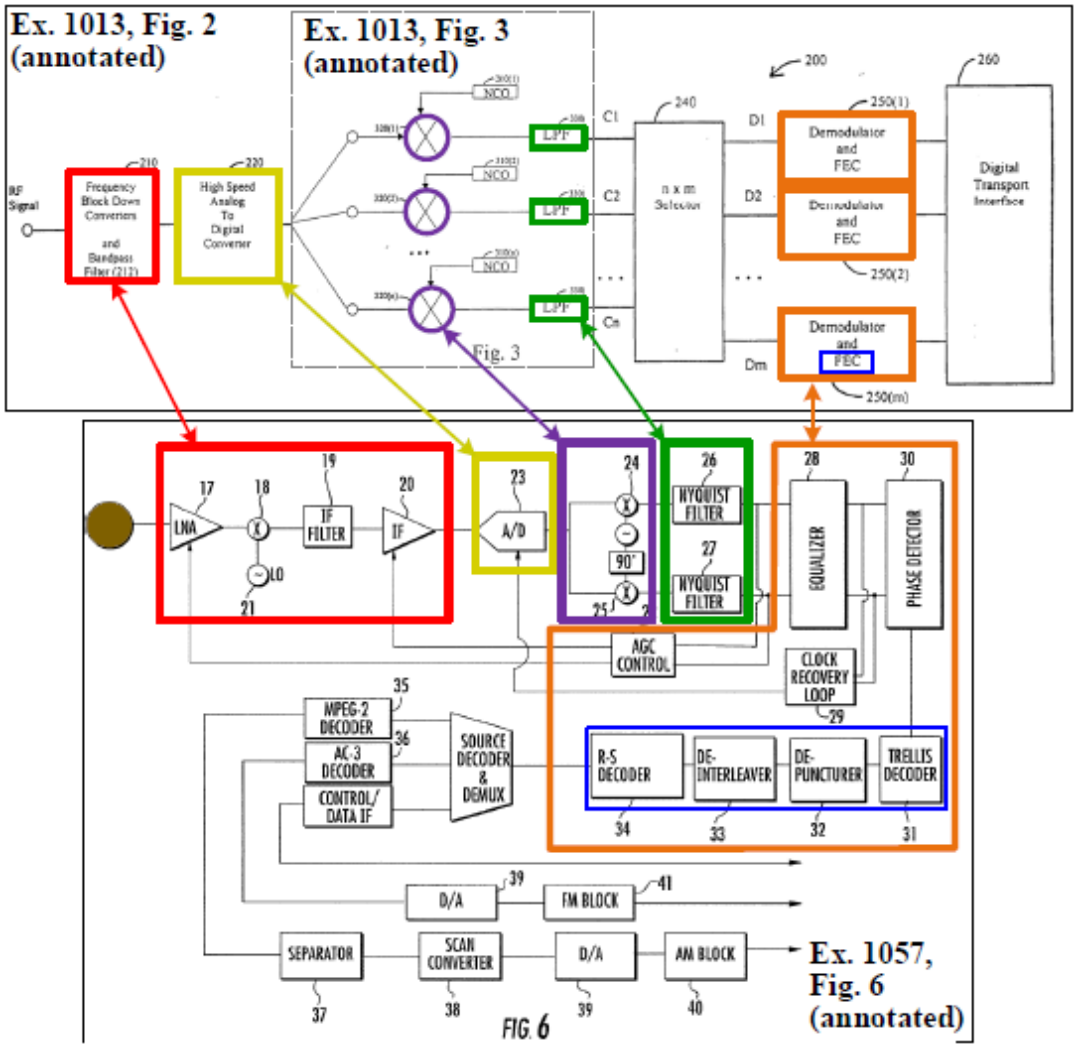
(Ex. 1057 (Jackson), Fig. 6;
'866 Pet., p. 9; Ex. 1002 (Lett '866 Dec.), ¶85;
'206 Pet., p. 10; Ex. 1002 (Lett '206 Dec.), ¶82)

Zhang-Jackson (only ’866/’206 IPRs)

A POSITA would have been motivated to implement:

- Zhang’s RF input using Jackson’s **input connector** because it would enable an installer to easily couple the receiver to the cable system.
- Zhang’s **converter 210** with Jackson’s **analog amplifiers and analog filters** because they would improve the performance of the system;
- Zhang’s **complex multipliers** as taught by Jackson because doing so would enable Zhang’s system to demodulate QAM modulated signals;
- Zhang’s **filters** with Jackson’s **filters** to isolate the I and Q components of Zhang’s 6 MHz selected channels; and
- Zhang’s **demodulator** as taught by Jackson because Jackson expressly shows its demodulator receiving and demodulating I and Q components of a complex signal to recover demodulated digital data.

(’866 Pet., pp. 63-71; Ex. 1002 (Lett ’866 Dec.), ¶¶228-248; ’206 Pet., pp. 60-68; Ex. 1002 (Lett ’206 Dec.), ¶¶215-235)



(Ex. 1013 (Zhang), Figs. 2-3; Ex. 1057 (Jackson), Fig. 6; ’866 Pet., pp. 59-60; Ex. 1002 (Lett ’866 Dec.), ¶222; ’206 Pet., pp. 56-57; Ex. 1002 (Lett ’206 Dec.), ¶209)

Zhang-Jackson (only ’866/’206 IPRs)

- Zhang-Jackson is relied on for various elements (including “cable network connector,” “analog amplifier,” “analog filter,” “in-phase (I) component,” “quadrature (Q) component,” “filtering the corresponding complex signal,” and “demodulating the corresponding complex signal”) in the following dependent claims:

Patent	Claims
’866	2-6, 15-19, 28-32, 42-46
’206	2-6, 14-18, 26-30, 39-43

Undisputed

(’866 Pet., pp. 59-71; ’206 Pet., pp. 56-68)

Zhang-Reisman-Jackson ('866/'206 IPRs)

- Some claims recite separate features found in Reisman and Jackson.
- The features in Jackson that are applied to Zhang are independent of the Reisman features (e.g., the addition of a DVR or picture-in-picture) added to Zhang.
- A POSITA would have added Jackson's teachings to Zhang-Reisman or Zhang with the same motivation and expectation of success.

('866 Pet., p. 61; Ex. 1002 (Lett '866 Dec.), ¶224;
'206 Pet., p. 58; Ex. 1002 (Lett '206 Dec.), ¶211)

- Reisman teaches "a DVR," "picture-in-picture display," "cable broadcast channel," and "DOCSIS" features, while Jackson teaches "cable network connector," "analog amplifier," "analog filter," "in-phase (I) component," "quadrature (Q) component," "filtering the corresponding complex signal," and "demodulating the corresponding complex signal" recited in the following claims:

Patent	Claims
'866	28-32, 42-46, 56-60, 70-74
'206	26-30, 39-43, 52-56, 65-69

('866 Pet., pp. 59-71; '206 Pet., pp. 56-69)

Undisputed

Zhang-Reisman-Pandey ('866/'206 IPRs)

- Some claims recite separate features found in Reisman and Pandey.
- The features in Pandey that are applied to Zhang are independent of the Reisman features (e.g., the addition of a DVR or picture-in-picture) added to Zhang.
- A POSITA would have added Pandey's teachings to Zhang-Reisman or Zhang with the same motivation and expectation of success.

('866 Pet., pp. 72-79; Ex. 1002 (Lett '866 Dec.), ¶¶251-262;
'206 Pet., pp. 69-75; Ex. 1002 (Lett '206 Dec.), ¶¶237-248)

- Reisman teaches "a DVR," "picture-in-picture display," "cable broadcast channel," and "DOCSIS" features, while Pandey teaches "via a serial interface" or "via a parallel interface" recited in the following claims:

Patent	Claims
'866	9-12, 22-25, 34-36, 48-50, 62-64, 76-78
'206	9-12, 21-24, 32-34, 45-47, 58-60, 71-73

Undisputed

('866 Pet., pp. 72-79; '206 Pet., pp. 69-75)

Zhang-Pandey-Jackson ('866/'206 IPRs)

- Some claims recite separate features found in Pandey and Jackson.
- The features in Jackson that are applied to Zhang are independent of the Pandey features (e.g., serial and parallel interfaces) added to Zhang.
- A POSITA would have added Jackson's teachings to Zhang-Pandey or Zhang with the same motivation and expectation of success.

('866 Pet., pp. 79-80; Ex. 1002 (Lett '866 Dec.), ¶¶263-264; '206 Pet., p. 75; Ex. 1002 (Lett '206 Dec.), ¶249)

- Pandey teaches "via a serial interface" or "via a parallel interface," while Jackson teaches "cable network connector," "analog amplifier," "analog filter," "in-phase (I) component," "quadrature (Q) component," "filtering the corresponding complex signal," and "demodulating the corresponding complex signal" recited in the following claims:

Patent	Claims
'866	2-6, 15-19
'206	2-6, 14-18

('866 Pet., pp. 79-80; '206 Pet., p. 75)

Undisputed

Prosecution History of the ’362, ’866, and ’206 Patents

Prosecution History ’362 Patent

- Non-statutory double patenting rejection
- NOA: “*the prior art failed to describe a wideband receiver system with ‘digital circuitry configured to select a plurality of desired television channels from the digitized plurality of frequencies and output said plurality of television channels to a demodulator as a digital datastream*.’”
- None of the petition’s prior art was considered during prosecution.
- Co-pending Reexamination
  - At the time of filing the petition, a request for *ex parte* reexamination (Control No. 90/019,255) was filed September 20, 2023, for claims 1 and 11 of the ’362 patent, and an Order granting the request was issued on November 1, 2023.
  - None of the petition’s prior art was cited as prior art in the reexamination.

(’362 Pet., pp. viii, 6-7; Ex. 1001 (’362 Patent), cover; Ex. 1004 (’362 Pros. History), pp. 75-79, 90-99, 107; Ex. 1022 (’362 Reexam File History), pp. 631-642)

Prosecution History ’866 and ’206 Patents

- Claims rejected over U.S. Patent No. 6,760,342 (Skones) in view of International Publication No. WO 02/087230 (Uskali).
- Claims allowed based on adding “serial interface,” “DVR,” or “picture-in-picture” to each independent claim.
- None of the petition’s prior art was considered during prosecution.
- PO does not dispute that the petition prior art (Zang, Zhang-Reisman) discloses the added features or that it would have been obvious to combine these features with the system in Zhang.

(’866 Pet., pp. 3-4; 1004 (’866 Pros. History), pp. 2-109, 119-132, 148-175
’206 Pet., pp. 4-5; Ex. 1004 (’206 Pros. History), pp. 2-9, 119-133, 220-242, 259-282)

Overview of the ’362, ’866, and ’206 patents

Overview of 362/866/206 Fig. 2 Embodiment

Four main blocks:

- *Radio Front End / Mixer Module (red)*
- *Analog to Digital Converters (gold)*
- *A plurality of Digital Down Converters (purple/green)*
- *Serial/Parallel Output to Demodulators (orange)*

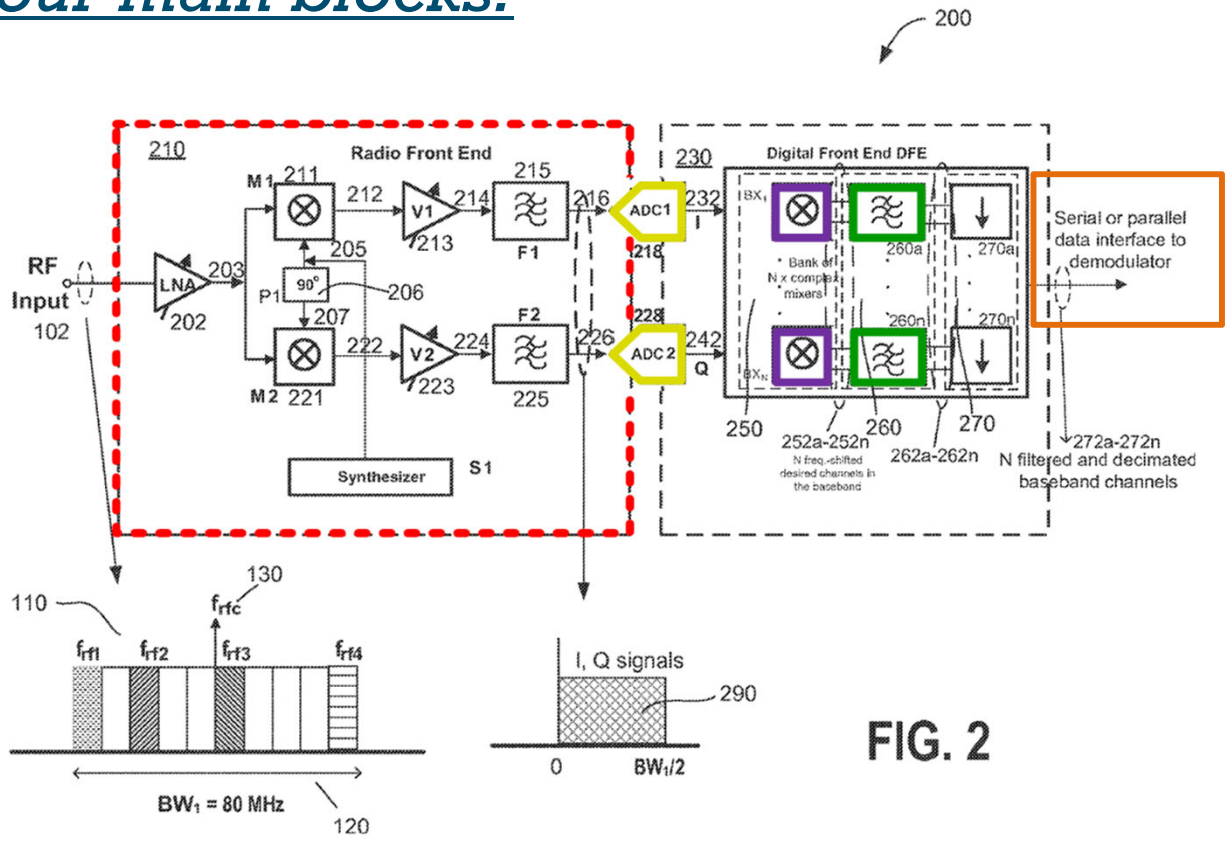


FIG. 2

('362 Pet., pp. 2-6; Ex. 1002 (Lett '362 Dec.), ¶¶ 36-42;
'866 Pet., pp. 2-3; Ex. 1002 (Lett '866 Dec.), ¶¶ 39-41;
'206 Pet., pp. 2-4; Ex. 1002 (Lett '206 Dec.), ¶¶ 36-38)

Overview of 362/866/206 Fig. 2 Embodiment.

Radio Front End / Mixer Module (red)

- The wideband receiver system 200 receives both desired and undesired television channels at frequencies dispersed within a frequency bandwidth BW_1.
- The desired channels are those that are shaded and the undesired channels are the empty spaces between the shaded channels.
- Radio Front End 210 (red) includes mixers "M1" and "M2" to split the incoming signal into in-phase and quadrature components that have been downconverted to "the baseband or low intermediate frequency (IF) band."
- Unwanted frequency components are filtered out by F1/F2 before the in-phase and the quadrature signal are passed to the ADCs.

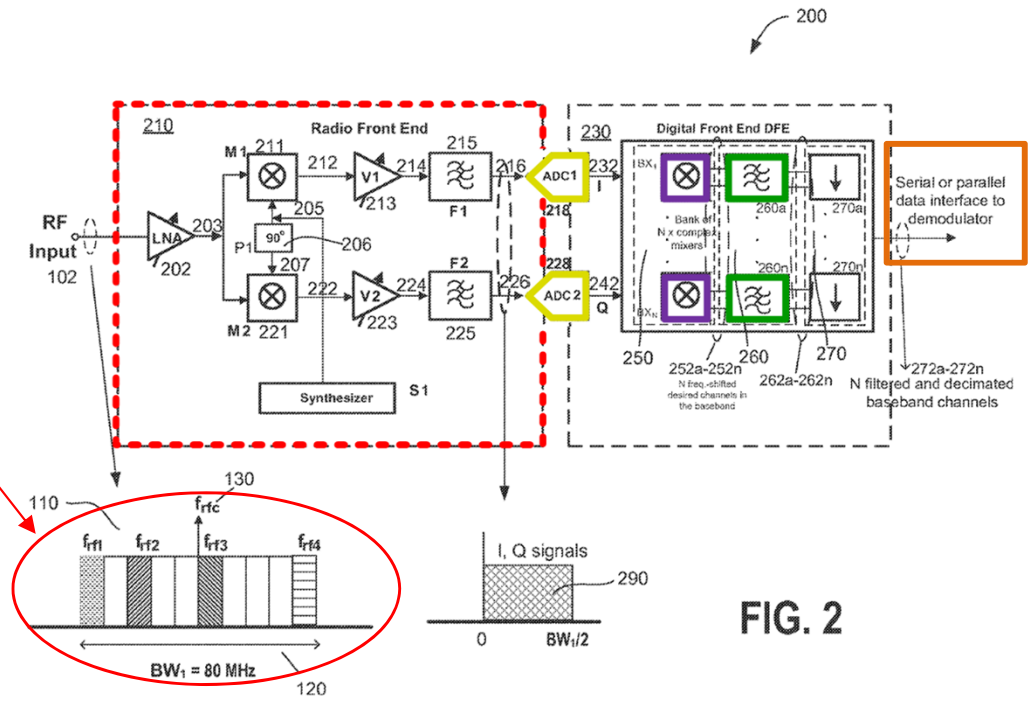


FIG. 2

('362 Pet., pp. 2-4; Ex. 1002 (Lett '362 Dec.), ¶¶ 37-38;
'866 Pet., pp. 1-2; Ex. 1002 (Lett '866 Dec.), ¶¶ 39-40;
'206 Pet., pp. 2-3; Ex. 1002 (Lett '206 Dec.), ¶¶ 36-37)

Overview of 362/866/206 Fig. 2 Embodiment.

Analog to Digital Converters (gold)

- The filtered I and Q analog signals are then individually digitized by wideband analog-to-digital converters ADC1 and ADC2 (gold) to generate I and Q digital signals.

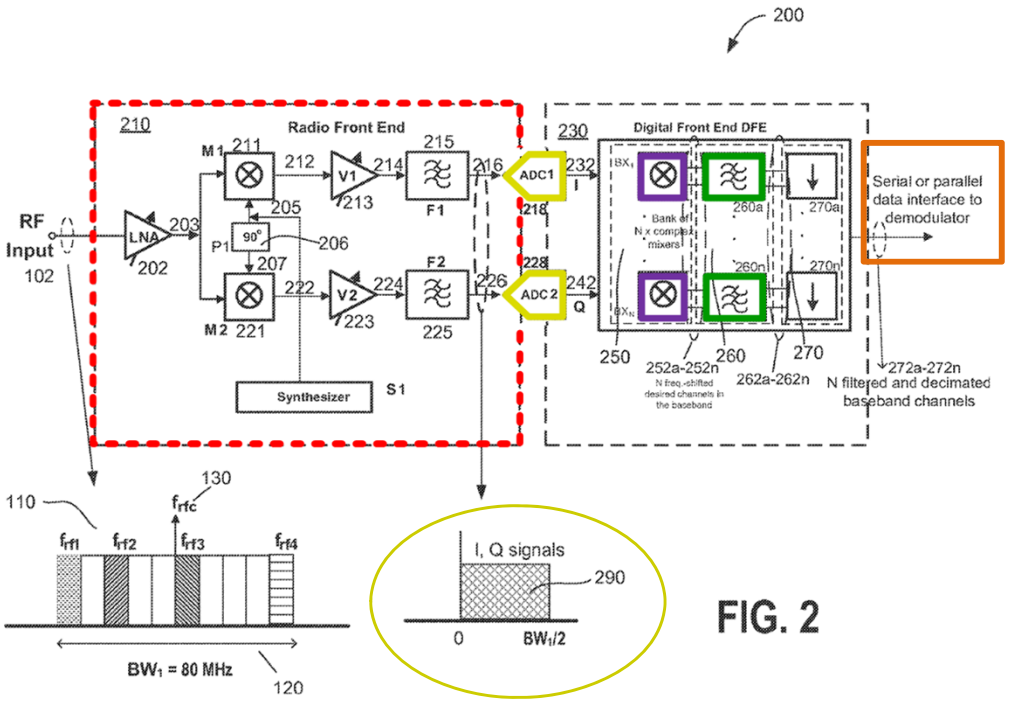


FIG. 2

('362 Pet., p. 4; Ex. 1002 (Lett '362 Dec.), ¶ 38;
'866 Pet., p. 2; Ex. 1002 (Lett '866 Dec.), ¶ 40;
'206 Pet., pp. 2-3; Ex. 1002 (Lett '206 Dec.), ¶ 37)

Overview of 362/866/206 Fig. 2 Embodiment.

Digital Front End (purple and green)

- The digital I and Q signals are input to a bank of N digital down converters, each including a complex mixer 250 (**purple**) followed by a filter 260 (**green**).
- "N is an integer value corresponding to the number of desired RF channels." Ex. 1001, 5:31-35.
- Each complex mixer 250 (**purple**) frequency-shifts one desired channel to the baseband frequency.
- The filter 260 (**green**) then filters the frequency-shifted signal so only the desired channel at baseband passes through.

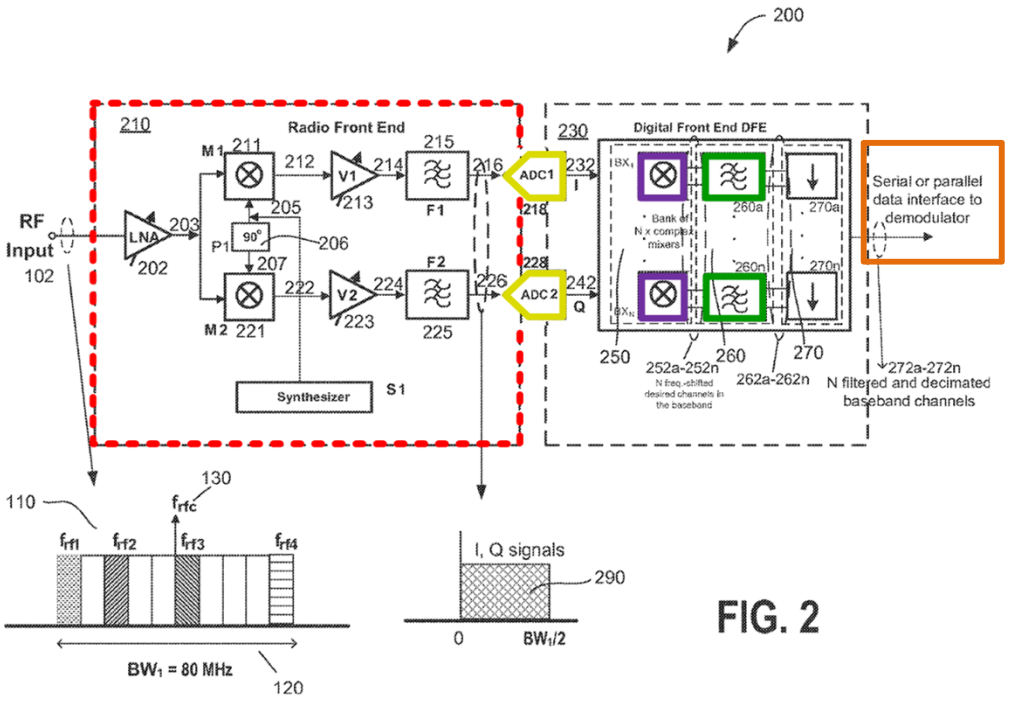


FIG. 2

('362 Pet., pp. 4-6; Ex. 1002 (Lett '362 Dec.), ¶¶ 39-41; '866 Pet., p. 3; Ex. 1002 (Lett '866 Dec.), ¶ 41; '206 Pet., p. 3; Ex. 1002 (Lett '206 Dec.), ¶ 38)

Overview of 362/866/206 Fig. 2 Embodiment.

Serial/Parallel Output to Demodulators (orange)

- The N desired channels will be sent as a serial or parallel digital data stream to a demodulator via a serial or parallel data interface (**orange**).

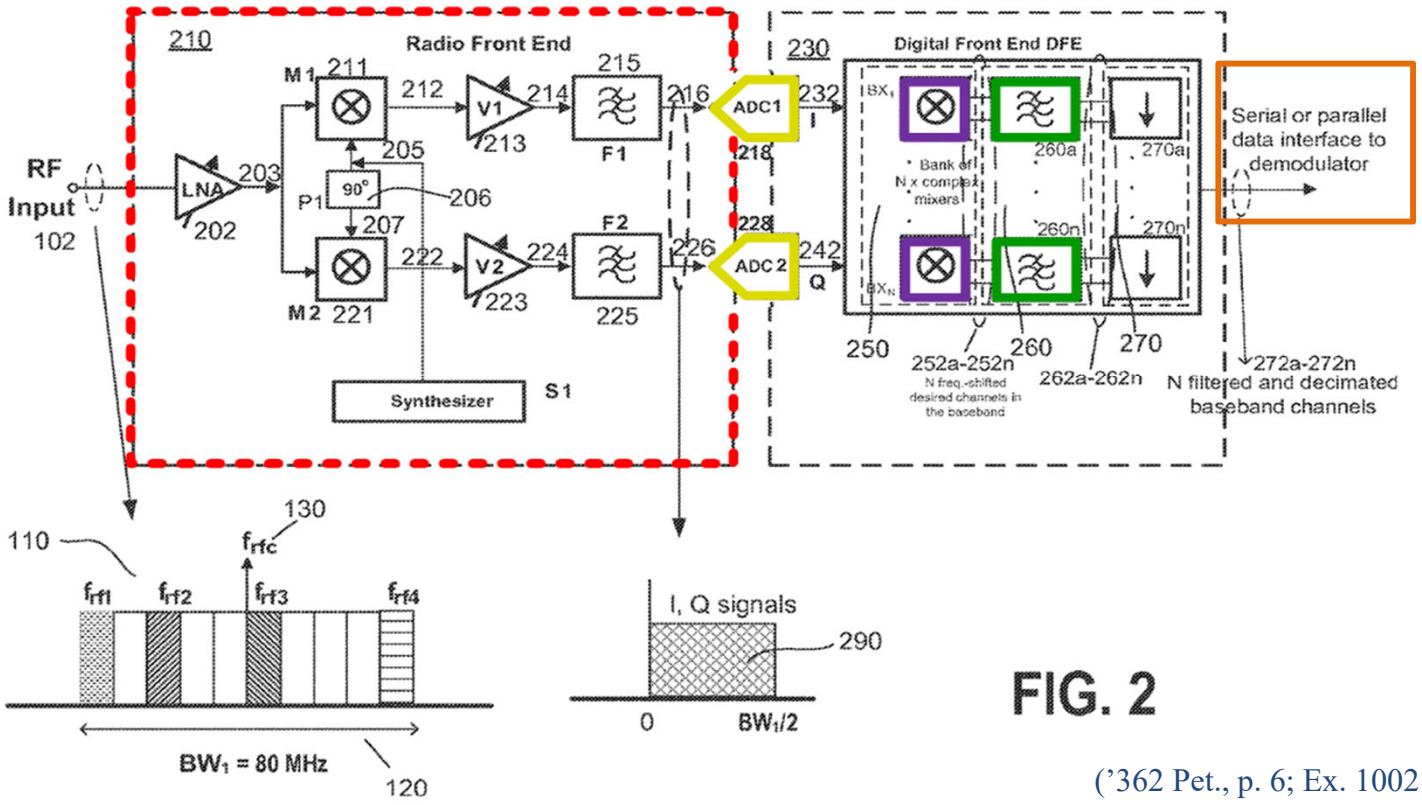


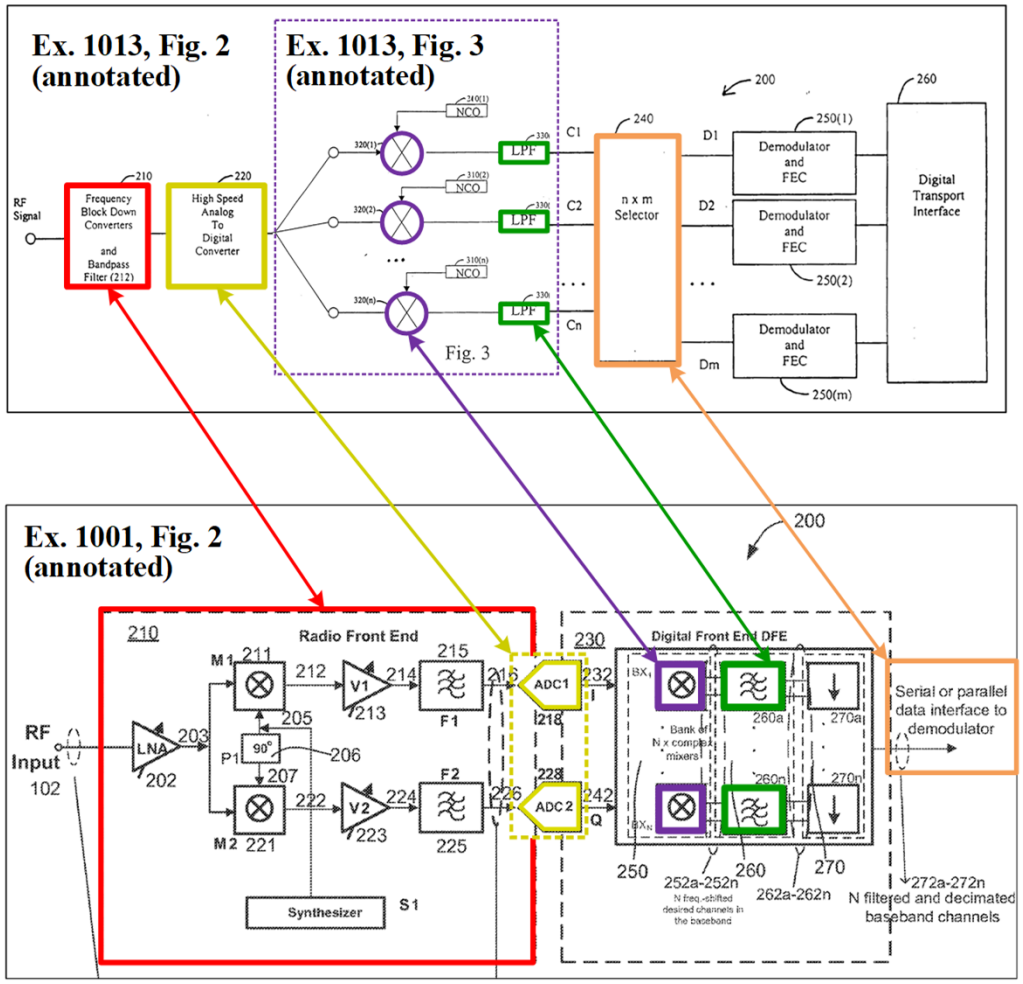
FIG. 2

('362 Pet., p. 6; Ex. 1002 (Lett '362 Dec.), ¶ 42;
'866 Pet., p. 3; Ex. 1002 (Lett '866 Dec.), ¶ 41;
'206 Pet., pp. 3-4; Ex. 1002 (Lett '206 Dec.), ¶ 38)

The ’362 Patent
(Undisputed Limitations)

Zhang

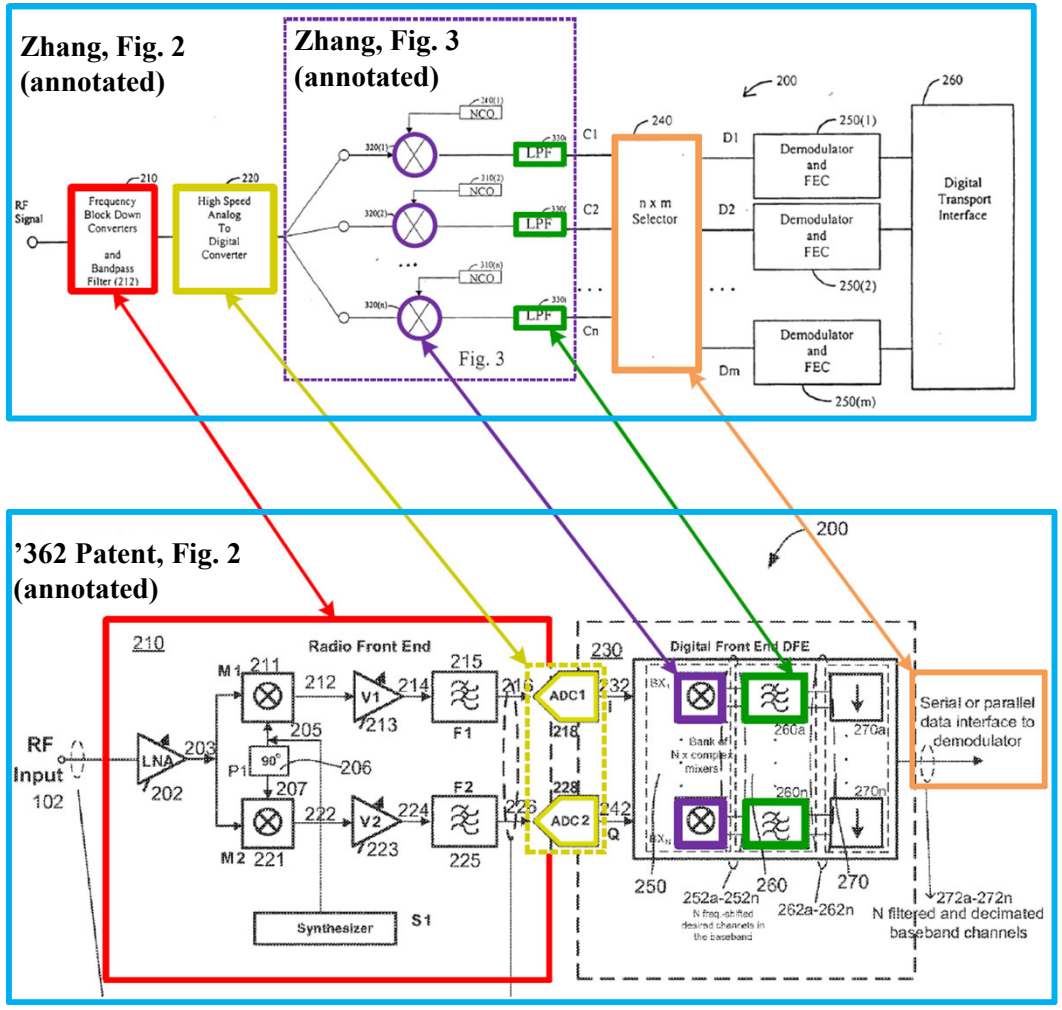
- Zhang and the challenged patents both include:
  - An analog mixer module (red) that frequency shifts a band of channels from a higher frequency to a lower frequency at which they can be digitized.
  - Analog-to-Digital Converters (gold) to convert the frequency band of channels from analog to digital.
  - Digital Down Converters, each including one multiplier (purple) and one filter (green) to select one desired channel from the digitized band of channels.
  - A serial or parallel Interface (orange) to output the selected desired channels.



(Ex. 1001 ('362 Pat.), Fig. 2 (annotated);
Ex. 1013 (Zhang), Figs. 2, 3 (annotated);
'362 Pet., pp. 8-11; Ex. 1002 (Lett '362 Dec.) ¶¶ 78-81;
'866 Pet., pp. 4-7; Ex. 1002 (Lett '866 Dec.) ¶¶ 77-80;
'206 Pet., pp. 5-8; Ex. 1002 (Lett '206 Dec.) ¶¶ 74-77)

’362 Patent - Zhang

Element	’362 Patent, Claim 1
1A	**1**. A wideband receiver system comprising:
1B	a mixer module configured to downconvert a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;
1C	a wideband analog-to-digital converter (ADC) module configured to digitize said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels;
1D	digital circuitry configured to: select said plurality of desired television channels from said digitized plurality of frequencies; and
1D	output said selected plurality of television channels to a demodulator as a digital datastream.



(Ex. 1001 (’362 Pat.), Fig. 2 (annotated);
Ex. 1013 (Zhang), Figs. 2, 3 (annotated);
’362 Pet., pp. 2-6, 8-11; Ex. 1002 (Lett ’362 Dec.), ¶¶ 36-42, 78-81)

’362 Patent – Zhang (Undisputed Limitations)

[1A] “A wideband receiver system comprising:”

Zhang, Ex. 1013, ¶ [0023]

[0023] **FIG. 2** is a simplified high-level block diagram of an exemplary multi-channel demodulator **200** according to an embodiment of the present invention. A frequency-block down-converter **210** receives one or more multi-channel analog RF signals which can be sourced by a variety of systems such as satellite systems, terrestrial TV systems, cable systems, etc.

Zhang, Ex. 1013, ¶ [0045]

[0045] Systems using the invention are enabled to perform advanced wide-band front-ends for digital set-top boxes, PVRs, home gateways and home media centers. **FIG. 8** is a

Zhang, Ex. 1013, Fig. 2

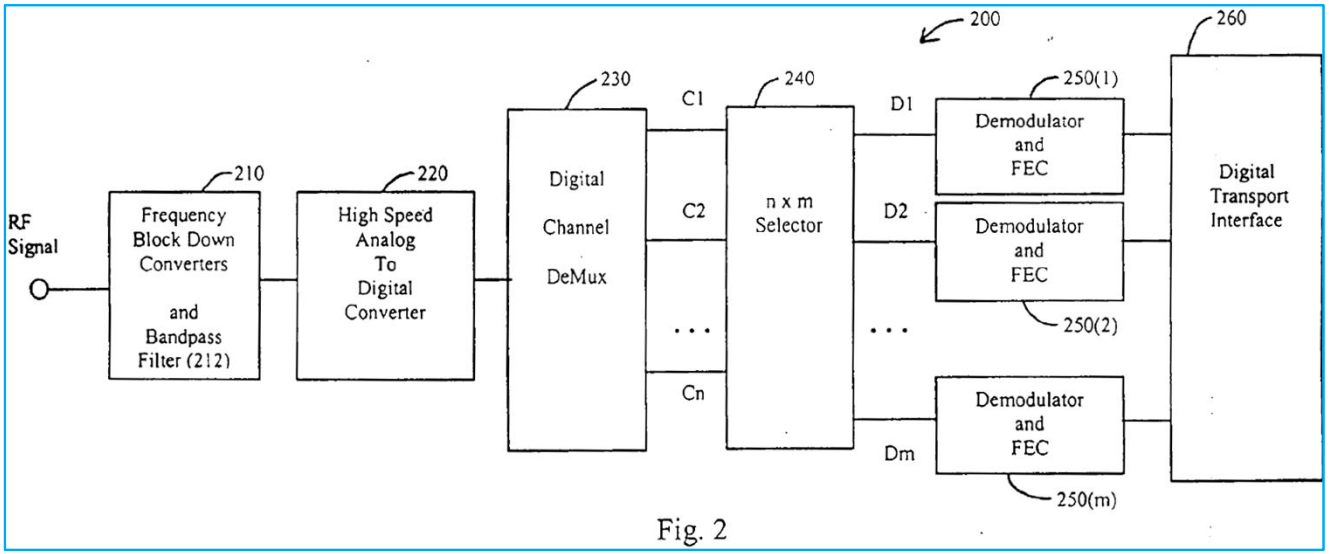


Fig. 2

(’362 Pet, pp. 23-25; Ex. 1002 (Lett ’362 Dec.), ¶¶ 98-100; Ex. 1013 (Zhang), ¶¶ [0023], [0045], Fig. 2; ’362 POR, pp. 1-3)

’362 Patent – Zhang (Undisputed Limitations)

[1B] “a mixer module configured to downconvert a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;”

Zhang’s Down Converter 210 is a “module configured to downconvert a plurality of frequencies.”

Zhang, ¶ [0025]

[0025] Down converter **210** shifts the multi-channel analog RF signal to a lower frequency band. The frequencies are simply downshifted, i.e., the frequency band of each RF channel and the guard bands remain the same relative to each other, but all are translated down by the same frequency. More specifically, the multi-channel analog RF signal is multiplied by a reference signal to a lower frequency band. Signal components outside the lower fre-

Background:
In Downconversion, Multiplying = Mixing

Typically, frequency downconversion of a passband signal is performed by multiplying (mixing) the signal with a sinusoid such as $\cos(2\pi f_{LO}t)$.

Mirabbasi, Ex. 1018, p. 5

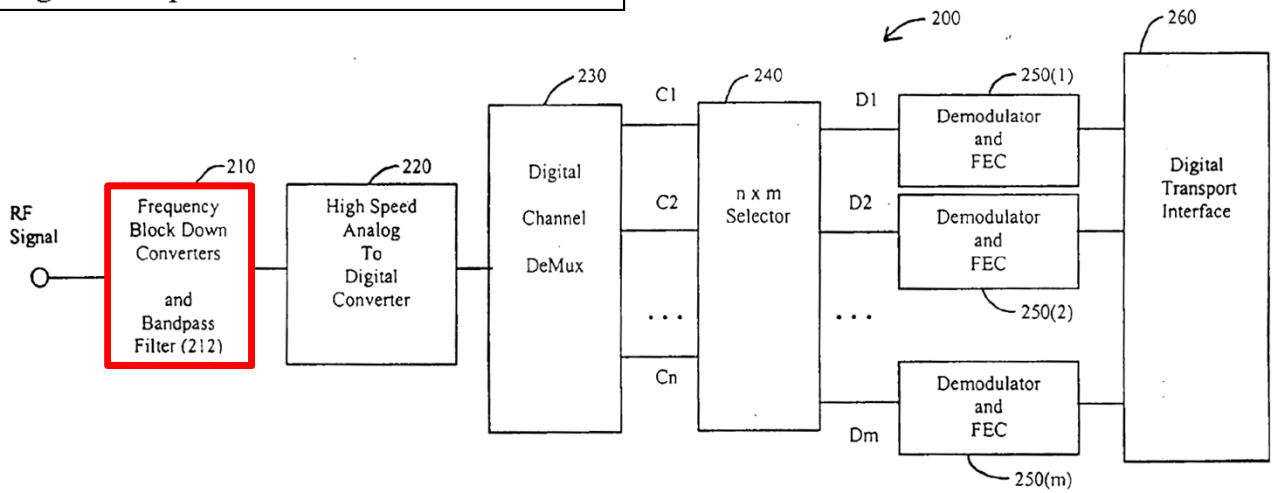


Fig. 2

(’362 Pet, pp. 25-26, 74-76; Ex. 1002 (Lett ’362 Dec.), ¶¶ 98-100, 215-219; Ex. 1013 (Zhang), ¶¶ [0025], Fig. 2; Ex. 1018 (Mirabbasi), 5; ’362 POR, pp. 1-3)

’362 Patent – Zhang (Undisputed Limitations)

[1B] “a mixer module configured to downconvert a plurality of frequencies that comprises a plurality of desired television channels and a plurality of undesired television channels;”

Zhang’s multi-channel signal “comprises a plurality of desired television channels and a plurality of undesired television channels”

Zhang refers to each digital downconverter chain tuning to a different “desired RF channel” and filtering out “undesired RF channels.”

[0032] Numeric oscillator **310(1)** generates a frequency, or “target” frequency, that matches the characteristic frequency of a desired RF channel, or “target” RF channel. The output of NCO **310(1)** is multiplied by all the RF channels received at complex multiplier **320(1)**. When an multi-channel RF signal is multiplied with the output of NCO **310(1)**, the frequency of target RF channel signal is shifted to a desired channel. In some embodiments of the present invention, the target RF channel is shifted to a baseband, i.e., centered at DC. LPFs **330(1** . . . n) receive all RF channels and each filters out all RF channels except for its target RF channel. Thus, only the target RF channel passes. Accordingly, separate RF channels exit digital tuner **300**, i.e., the multi-channel RF signal is demultiplexed. Digital tuner circuit **300** then outputs the separated RF channels C_1 to C_n, each RF channel being centered at baseband.

Zhang, ¶ [0032]

37. The method of claim 34 further comprising filtering undesired RF channels and passing only the target RF channel.

Zhang, claim 37

Patent Owner and its Expert acknowledge that Zhang’s plurality of frequencies include desired and undesired channels

In Zhang, creating an output of desired channels is achieved through a different method, which I explain in the context of Zhang’s Figures 2 and 3, annotated below. Similar to the ’362 patent, Zhang digitizes an input signal (yellow), consisting of “n” channels, both desired and undesired, in the analog to digital converter 220 (yellow). Ex. 1013 [Zhang] [0027] (“In this specific embodiment, ADC 220 is a high-speed ADC so that an entire signal band with n channels can be converted”). Note that the letter “n” in Zhang denotes the number of

’362 PO Resp., p. 4 (quoting Ex. 2009 (Russ Dec.), ¶ 33)

(’362 Pet, p. 26; Ex. 1002 (Lett ’362 Dec.), ¶¶ 103-106; Ex. 1013 (Zhang), ¶¶ [0032], Claim 37, Fig. 2; Ex. 2009 (Russ Dec.), ¶ 33; ’362 PO Resp., pp. 1-4)

’362 Patent – Zhang (Undisputed Limitations)

[1C] “a wideband analog-to-digital converter (ADC) module configured to digitize said plurality of frequencies comprising said plurality of desired television channels and said plurality of undesired television channels;”

[0027] An ADC **220** then converts the down-converted multi-channel analog RF signal to a multi-channel digital RF signal. In this specific embodiment, ADC **220** is a high-speed ADC so that an entire signal band with n channels can be converted.

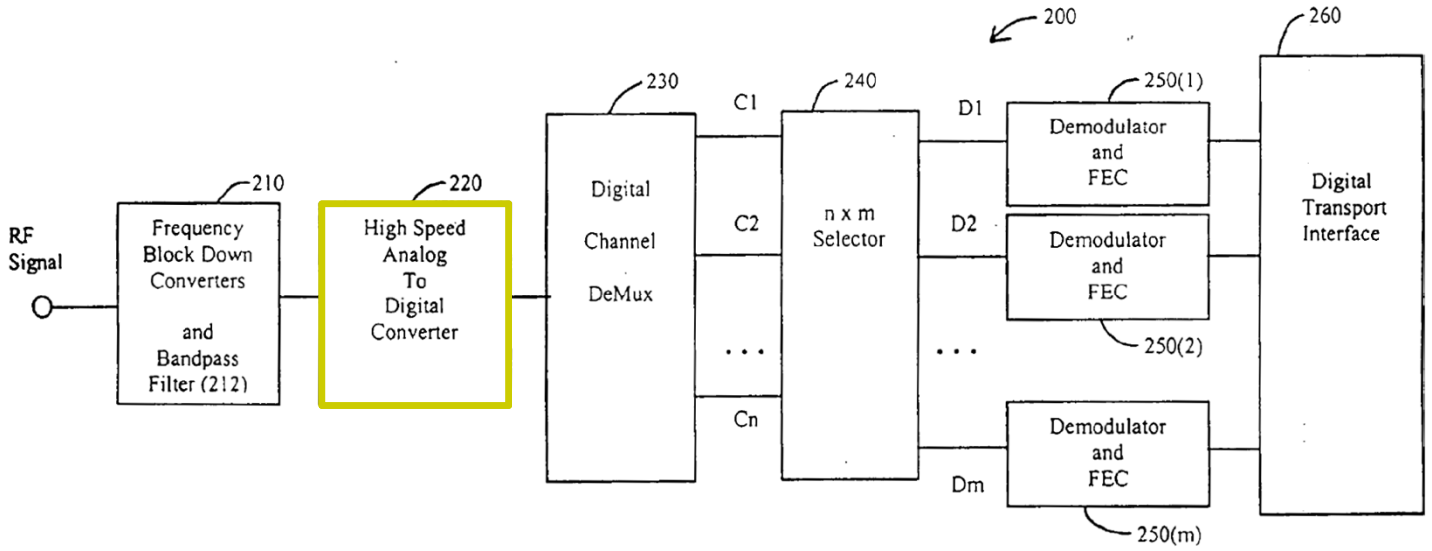


Fig. 2

(’362 Pet, pp. 27-28; Ex. 1002 (Lett ’362 Dec.), ¶¶ 108-110; Ex. 1013 (Zhang), ¶ [0027], Fig. 2 ; ’362 POR, pp. 1-3)

The ’866 and ’206 Patents (Undisputed Limitations)

’866 Patent – Zhang (Undisputed Limitations)

- [1A]/[14A] “A cable television (TV) device comprising:”
- [1B]/[14B] “a wideband analog-to-digital converter (ADC) configured to digitize [*a contiguous band of frequencies in an input signal / an input signal*], wherein the [*contiguous band of frequencies / input signal*] comprises a plurality of desired channels and a plurality of undesired channels; and”

** Claims 27, 41, 55, and 69 include identical elements

“ADC 220 … converts the … multi-channel analog RF signal to a multi-channel digital RF signal.” [0027].

“FIG. 2 is a simplified high-level block diagram of an exemplary multi-channel demodulator 200 … receives one or more multi-channel analog RF signals which can be sourced by a variety of systems such as satellite systems, terrestrial TV systems, cable systems, etc. [0023]

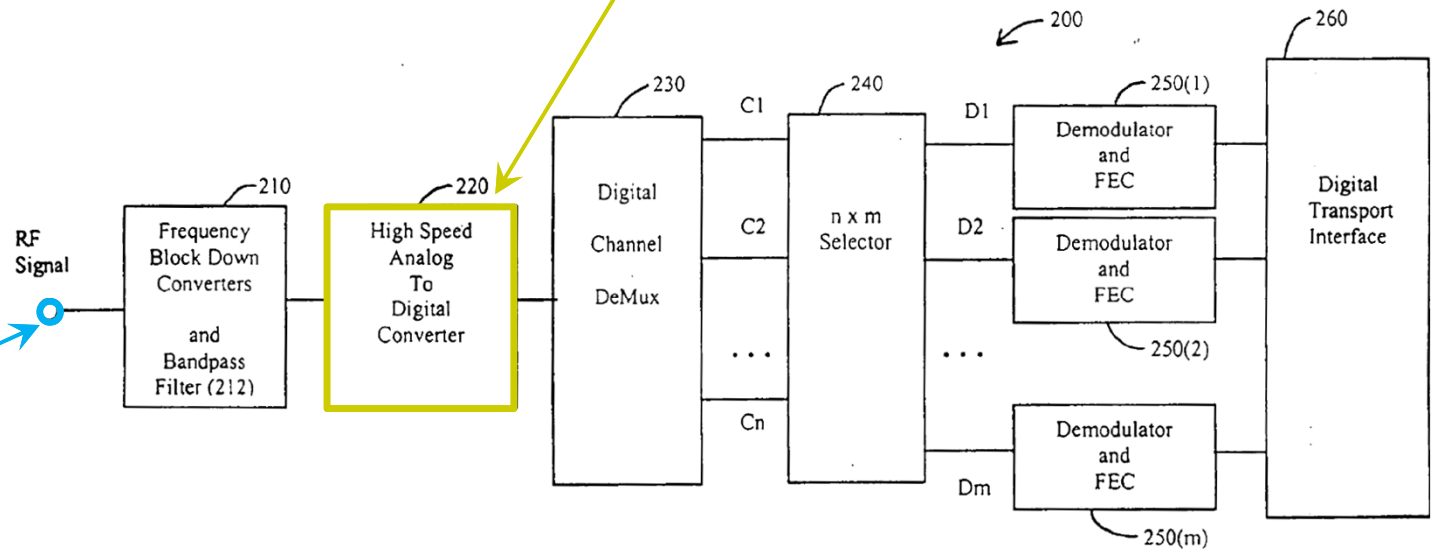


Fig. 2

(’866 Pet, pp. 20-22; Ex. 1002 (Lett ’866 Dec.), ¶¶ 101-107; Ex. 1013 (Zhang), ¶¶ [0023], [0027], Fig. 2; ’866 POR, pp. 1-3)

’206 Patent – Zhang (Undisputed Limitations)

[1A]/[13A] “A method [*for receiving a television (TV) signal*] comprising:”

[1B]/[13B] “receiving an input signal from a cable network;”

[1C]/[13C] “digitizing [*a contiguous band of frequencies/all received channels*] in the input signal via a wideband analog-to-digital converter (ADC), wherein [the contiguous band of frequencies comprises all received channels that exist in the input signal and] the received channels comprise a plurality of desired channels and a plurality of undesired channels;”

[1E]/[13E] “providing the plurality of [*desired channels/digital channel outputs*] via a serial interface.”

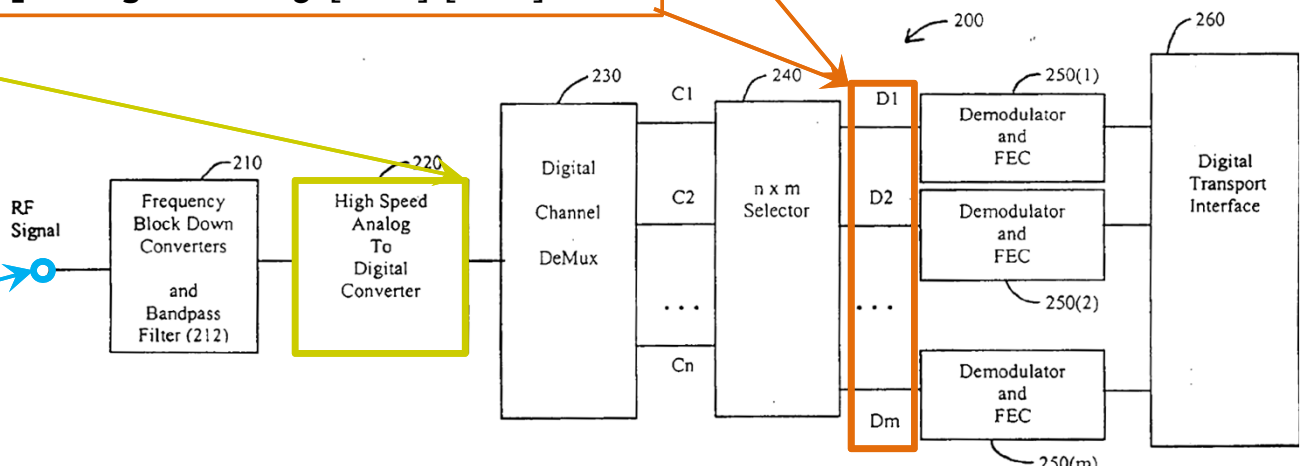
** Claims 25, 38, 51, and 64 include identical elements

“ADC 220 … converts the … multi-channel analog RF signal to a multi-channel digital RF signal.” Zhang, [0027].

“[D]igital selector 500 digitally selects … D1 to Dm from ….C1 to Cn and then sends them to appropriate demodulators … through different data buses …. Because a bus clock is much faster than the channel-sampling rate, each bus can be used by multiple RF channels with the use of **time division multiplexing** ….” Zhang, [0038]-[0039].

“[A] POSITA would have understood [] that Zhang’s **time division multiplexing** involves sending different channels sequentially in different time divisions over a single data path as shown, and that such a path **was known as a “serial interface”** … Ex. 1002, ¶ 117.

“FIG. 2 is a simplified high-level block diagram of an exemplary multi-channel demodulator 200 … receives one or more multi-channel analog RF signals which can be sourced by a variety of systems such as satellite systems, terrestrial TV systems, cable systems, etc. Zhang, [0023]



(’206 Pet., pp. 20-23, 26-30, 33; Ex. 1002 (Lett ’206 Dec.), ¶¶ 98-108, 115-121, 123-128, 135-136; Ex. 1013 (Zhang), ¶¶ [0023], [0027], [0038]-[0039], Fig. 2)

Additional Slides

Claim Differentiation Does Not Apply Across Patents With Substantially Different Claim Language

'362 Patent Owner's Response, pp. 33-35

'362 Patent Limitation 1[d] and 11[d]	'866 Patent Limitation 1[b][*sic:* 1[d]]
Limitation 1[d] : "select said plurality of desired television channels from said digitized plurality of frequencies" Limitation 11[d]: "selecting, by digital circuitry of said wideband receiver system, said plurality of desired television channels from said digitized plurality of frequencies"	"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."

('362 Pet. Reply, pp. 13-14)

Claim Differentiation Does Not Apply Across Patents With Substantially Different Claim Language

'206 Patent Owner's Response, pp. 34-36

'206 Patent Limitation 1[d]	'866 Patent Limitation 1[b] [*sic:* 1[d]]
"concurrently selecting each of the plurality of desired channels from the input signal without selecting any of the plurality of undesired channels"	"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."

('206 Pet. Reply, pp. 12-14)

Claim Differentiation Does Not Apply Across Patents With Substantially Different Claim Language

- Patent Owner alleges support from:
  - *SightSound Techs., LLC v. Apple Inc.*, 809 F.3d 1307, 1318 (Fed. Cir. 2015)
  - *Curtiss-Wright Flow Control Corp. v. Velan, Inc.*, 438 F.3d 1374, 1380 (Fed. Cir. 2006)
  - *Clare v. Chrysler Group LLC*, 819 F.3d 1323, 1330-1331 (Fed. Cir. 2016)
- *SightSound Techs.* and *Curtiss-Wright Flow Control*, involve comparing nearly identical claims within the same patent.
  - The claim elements Patent Owner compares are from different patents and have significantly different language and features.
- In *Clare*, the Court rejected the claim differentiation doctrine because the result would have excluded the preferred embodiment in the specification.
  - Likewise, PO's argument would exclude the Fig. 2 embodiment in the '362 and '206 patents, which does not directly select desired channels from the input signal.

('362 PO Resp., pp. 34-35; '362 Pet. Reply, pp. 13-14
'206 PO Resp., pp. 35-36; '206 Pet. Reply, pp. 13-14)