

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

COMCAST CABLE COMMUNICATIONS, LLC,
Petitioner,

v.

ENTROPIC COMMUNICATIONS, LLC,
Patent Owner.

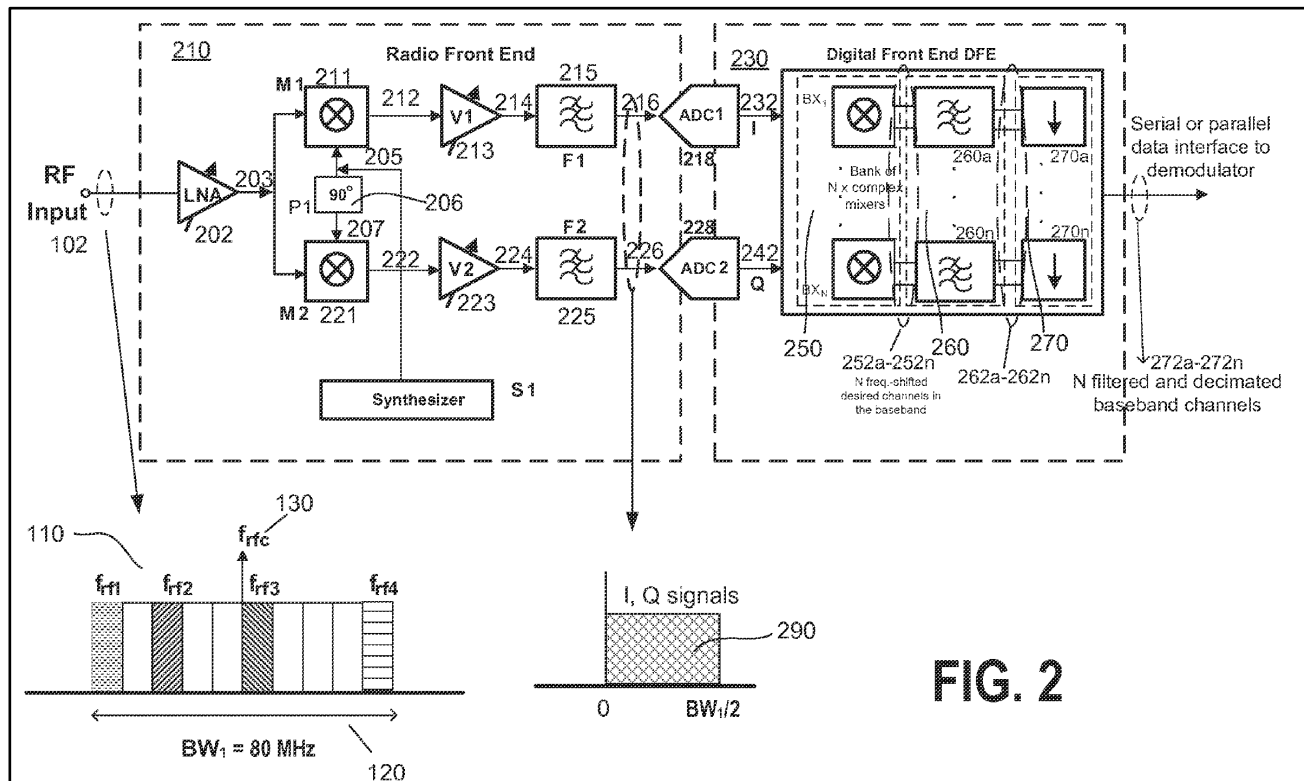
Case IPR2025-00180
Patent 11,785,275 B2

Before JEFFREY S. SMITH, MICHELLE N. WORMMEESTER, and SCOTT B. HOWARD,
Administrative Patent Judges.

Petitioner's Demonstrative Exhibit

Introduction

- The '275 patent is related to and shares the same specification and drawings as U.S. patents 9,210,362; 11,381,866; and 11,399,206 – all of which were found unpatentable in prior IPRs. (Reply, 1)
- Like the claims in the prior IPRs, the '275 patent claims are directed to a television receiver as illustrated in Fig. 2:



(Ex. 1001 ('275 Patent), Fig. 2; Petition, 2-6; Ex. 1002 (Lett Dec.), ¶¶ 36-42)

Independent Claims 1 and 11

'275 Patent, Claim 1

[1A] A method for operating a television receiver, comprising:

[1B] receiving, by an input terminal, an input signal comprising broadcast channels, the broadcast channels comprising a plurality of desired channels and a plurality of undesired channels, wherein the plurality of desired channels are non-contiguous;

[1C] processing, by a radio front end coupled to the input terminal, the input signal to generate a processed input signal;

[1D] digitizing, by an analog-to-digital converter (ADC) coupled to the radio front end, the processed input signal to generate a digitized signal;

[1E] selecting, by a digital frontend (DFE) coupled to the ADC, the plurality of desired channels from the digitized signal; and

[1F] outputting, by the DFE, the selected plurality of desired channels to at least one demodulator as a digital datastream, wherein the demodulator extracts information encoded in the digital datastream.

'275 Patent, Claim 11

[11A] A television receiver device, comprising:

[11B] an input terminal operable to receive an input signal comprising broadcast channels, the broadcast channels comprising a plurality of desired channels and a plurality of undesired channels, wherein the plurality of desired channels are non-contiguous;

[11C] a radio front end, coupled to the input terminal, operable to process the input signal;

[11D] an analog-to-digital converter (ADC), coupled to the radio front end, operable to digitize the processed input signal to generate a digitized signal; and

[11E] a digital frontend (DFE), coupled to the ADC, operable to select the plurality of desired channels from the digitized signal and

[11F] output the selected plurality of desired channels to at least one demodulator as a digital datastream, wherein the demodulator is operable to extract information encoded in the digital datastream.

(Petition, 14-15, 79-80; POR, 13-14; Reply, 1-2; Sur-Reply, 1, 20)

UNDISPUTED

DISPUTED

DISPUTED
FOR
MAPPING 1
ONLY

Comparison with Claims of the '362/'866/'206 Patents

'275 Patent, Claim 1

[1A] A method for operating a television receiver, comprising:

[1B] receiving, by an input terminal, an input signal comprising broadcast channels, the broadcast channels comprising a plurality of desired channels and a plurality of undesired channels, wherein the plurality of desired channels are non-contiguous;

[1C] processing, by a radio front end coupled to the input terminal, the input signal to generate a processed input signal;

[1D] digitizing, by an analog-to-digital converter (ADC) coupled to the radio front end, the processed input signal to generate a digitized signal;

[1E] selecting, by a digital frontend (DFE) coupled to the ADC, the plurality of desired channels from the digitized signal; and

[1F] outputting, by the DFE, the selected plurality of desired channels to at least one demodulator as a digital datastream, wherein the demodulator extracts information encoded in the digital datastream.

'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.

Found unpatentable
(Ex. 1090 ('362 FWD), 6, 29, 35)

'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.

Found unpatentable
(Ex. 1091 ('866 FWD), 5-6, 24, 46-47)

'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.

Found unpatentable
(Ex. 1092 ('206 FWD), 5-6, 28, 48-49)

(Reply 1)

Overview of the '275 Patent - 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), 5)

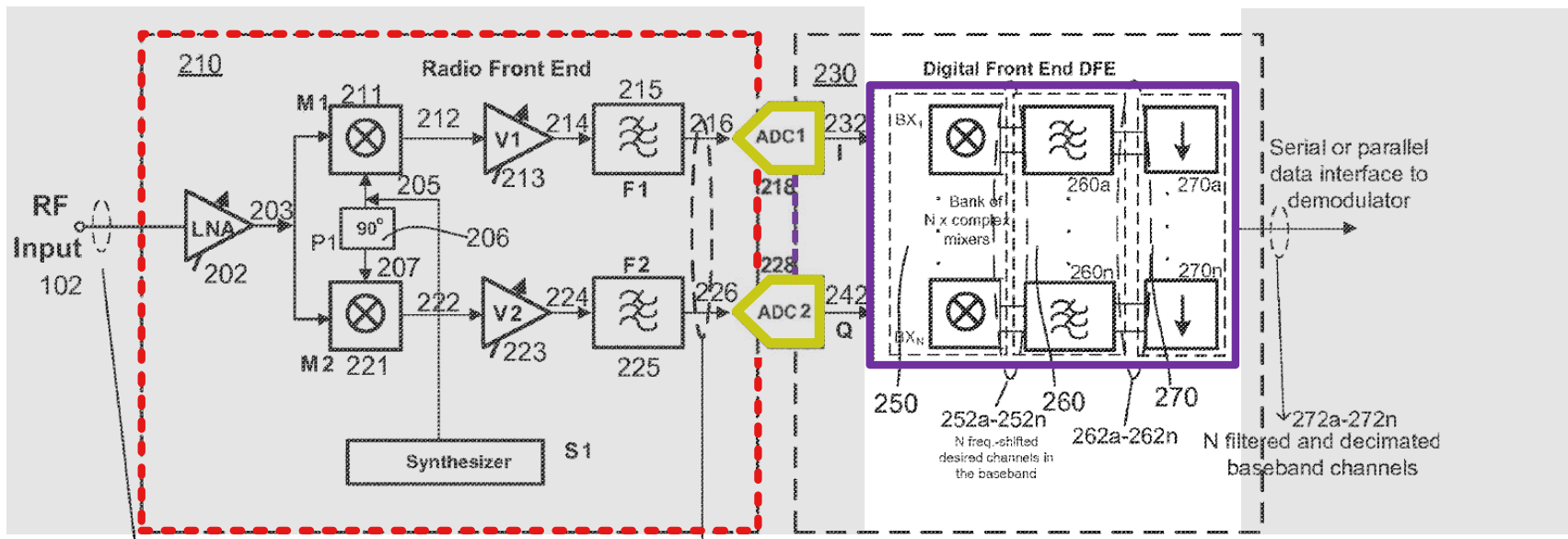
'275 Patent

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. This approach provides several advantages over conven-

(Ex. 1001 ('275 Pat.), 7:16-20)

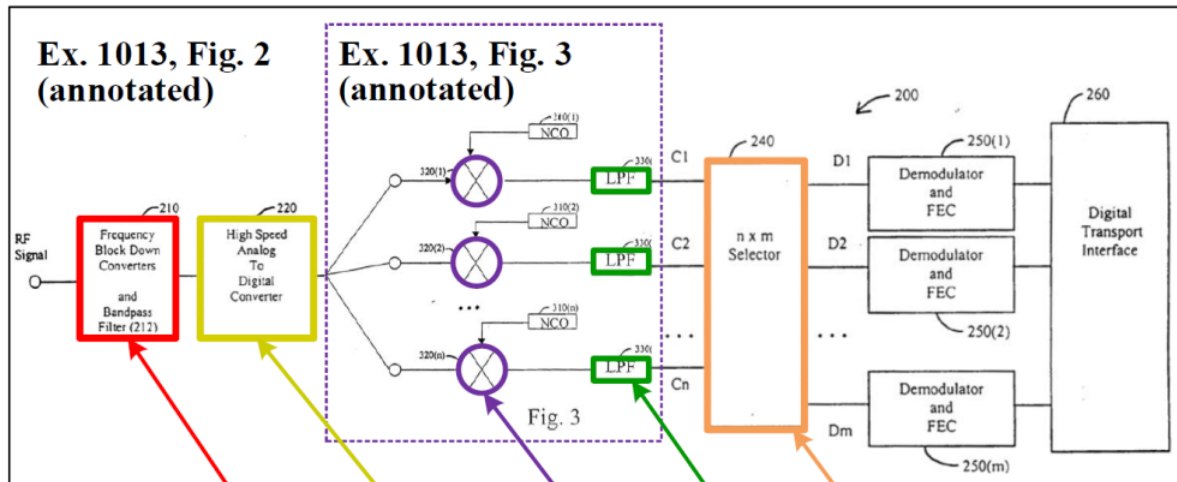
"conventional tuner[]"

"commonly known"



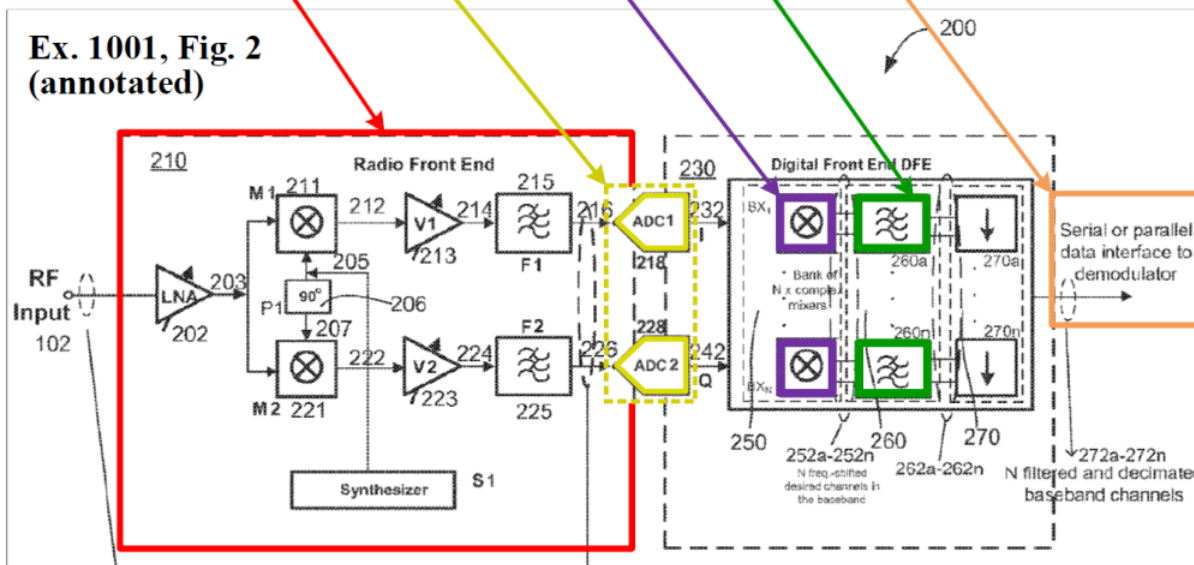
(Petition, 2-6; Ex. 1002 (Lett Dec.), ¶¶ 36-42)

Zhang Compared to the '275 Patent



Zhang and the '275 patent 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)



(Reply, 7; Ex. 1085, (Lett Reply Dec.), ¶ 6; Petition, 7-9; Ex. 1002 (Lett Dec.), ¶¶ 80-81)

PO Does Not Dispute that Zhang Selects Desired Channels

Final Written Decision from '362 patent IPR:

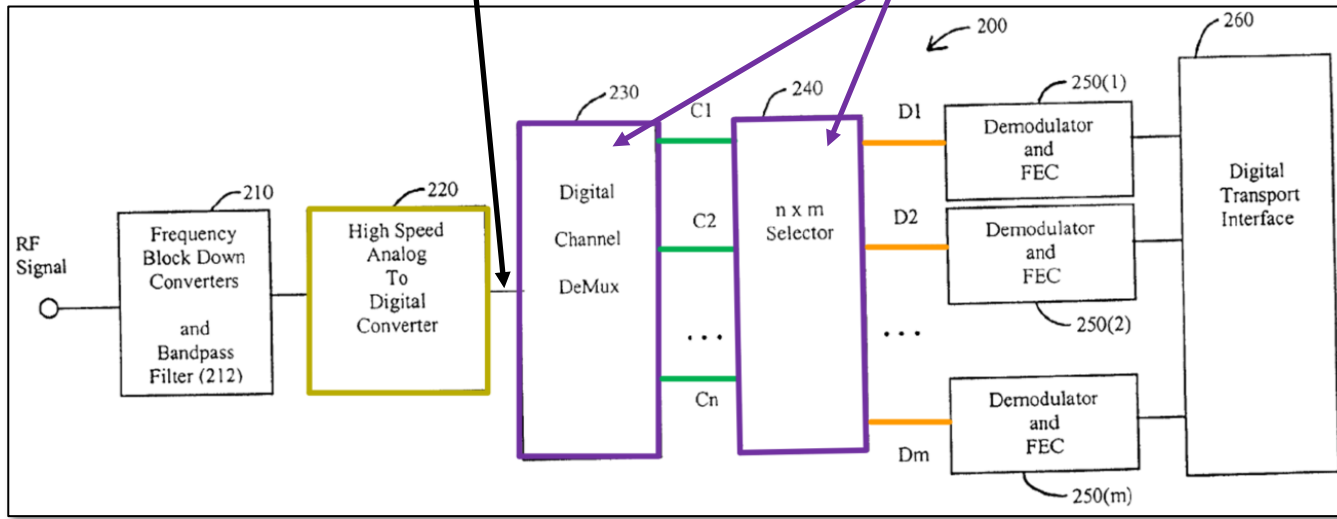
71:14-17 (PO Counsel: "There is no dispute that in both Zhang and the patent, an RF signal that has both desired and undesired channel comes in and what's sent to demodulators are desired channels. Nobody is disputing that."), 134:3-5 (PO Counsel: "The issue is not whether the black box 230-plus-240 is the digital circuitry. It is. The issue is not whether or not that overall circuitry selects channels. At some level, it does."). In other words,

Zhang teaches digital circuitry that is (1) capable of receiving a plurality of frequencies including desired/undesired television channels and (2) capable of distinguishing between the desired/undesired channels to output the desired television channels to a demodulator. We find these uncontested facts to be highly probative of Petitioner's contention that, to a skilled artisan, Zhang suggests that its digital circuitry is capable of selecting the desired television channels from a digitized plurality of frequencies that include both desired/undesired television channels. This is because Zhang's

(Ex. 1090 ('362 FWD), 22)

PO admits input is desired and undesired channels

PO admits Zhang 230 plus 240 selects desired channels



(Ex. 1013 (Zhang), Fig. 2)

(Reply, 3, 6)

Zhang Compared to the '275 Patent

- Zhang and the '275 patent use the same **multiplier-filter** circuit for selecting the desired channels and filtering out undesired channels.

Zhang

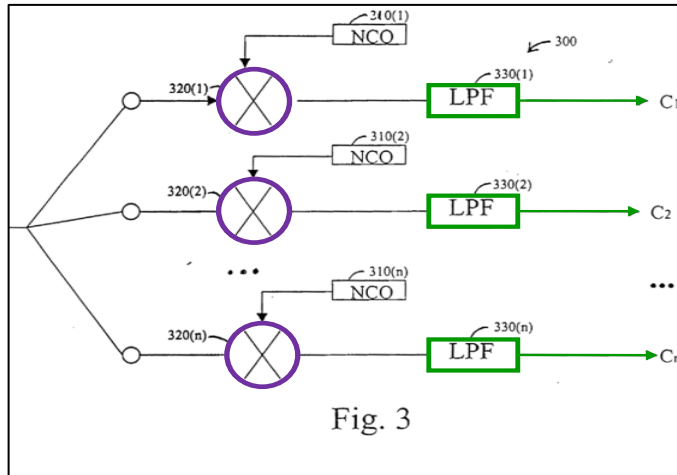


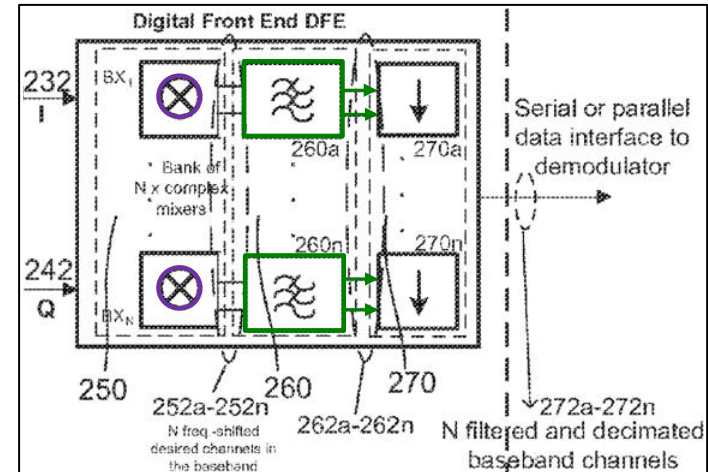
Fig. 3

(Ex. 1013 (Zhang), Fig. 3 (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), [0030])

'275 Patent



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

tion 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 under-

(Ex. 1001, 5:56-60)

(Petition, 7-9, 31-33; Ex. 1002 (Lett Dec.), ¶¶ 80-82, 129-134; Reply, 8-12, 15-17; Ex. 1085, (Lett Reply Dec.), ¶¶ 6, 11-18)

Zhang Compared to the '275 Patent

Zhang and the '275 patent 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), [0032])

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

(Ex. 1013 (Zhang), [0028])

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

(Ex. 1013 (Zhang), Claim 37)

(Petition, 7-9, 31-33; Ex. 1002 (Lett Dec.), ¶¶ 80-82, 129-134; Reply, 8-12, 15-17; Ex. 1085, (Lett Reply Dec.), ¶¶ 6, 11-18)

'275 Patent

Multipliers 313, 315, 323, and 325 are identical digital multipliers. In an embodiment, a numerically controlled oscillator with quadrature output generates the $\cos(\Omega_{ct}t)$ and $\sin(\Omega_{ct}t)$ 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_{ct} 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_{ct}) 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 260a-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 certain embodiments, filters 330 and 340

(Ex. 1001, 6:53-7:8)

tional 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, 7:21-25)

Grounds of Invalidity

The only dispute is whether Zhang teaches selecting and outputting desired channels as recited in independent claims 1 and 11 (highlighted red).

	References	Basis	Claims Challenged
A	Zhang	§102	1-3, 5, 7-10
			11-13, 15, 17-20
B	Zhang	§103	1-3, 5, 7-10
			11-13, 15, 17-20
C	Zhang-Pandey	§103	2-3, 12-13
D	Zhang-Zhang '933	§103	2, 12
E	Zhang-Mirabbasi	§103	4, 11-15, 17-20
F	Zhang-Dong	§103	5-6, 15-16
G	Zhang-Mirabbasi-Pandey	§103	12-13
H	Zhang-Mirabbasi-Zhang '933	§103	12
I	Zhang-Mirabbasi-Dong	§103	15-16

(Petition, 14-15; POR, 13-14; Reply, 1-2; Sur-Reply, 1, 20)

Overview of Representative Independent Claim 1

'275 Patent, Claim 1

[1A] A method for operating a television receiver, comprising:

[1B] receiving, by an input terminal, an input signal comprising broadcast channels, the broadcast channels comprising a plurality of desired channels and a plurality of undesired channels, wherein the **plurality of desired channels are non-contiguous**;

[1C] processing, by a radio front end coupled to the input terminal, the input signal to generate a processed input signal;

[1D] digitizing, by an analog-to-digital converter (ADC) coupled to the radio front end, the processed input signal to generate a digitized signal;

[1E] selecting, by a digital frontend (DFE) coupled to the ADC, the plurality of desired channels from the digitized signal; and

[1F] outputting, by the DFE, the selected plurality of desired channels to at least one demodulator as a digital datastream, wherein the demodulator extracts information encoded in the digital datastream.

'275 Patent, Figure 2

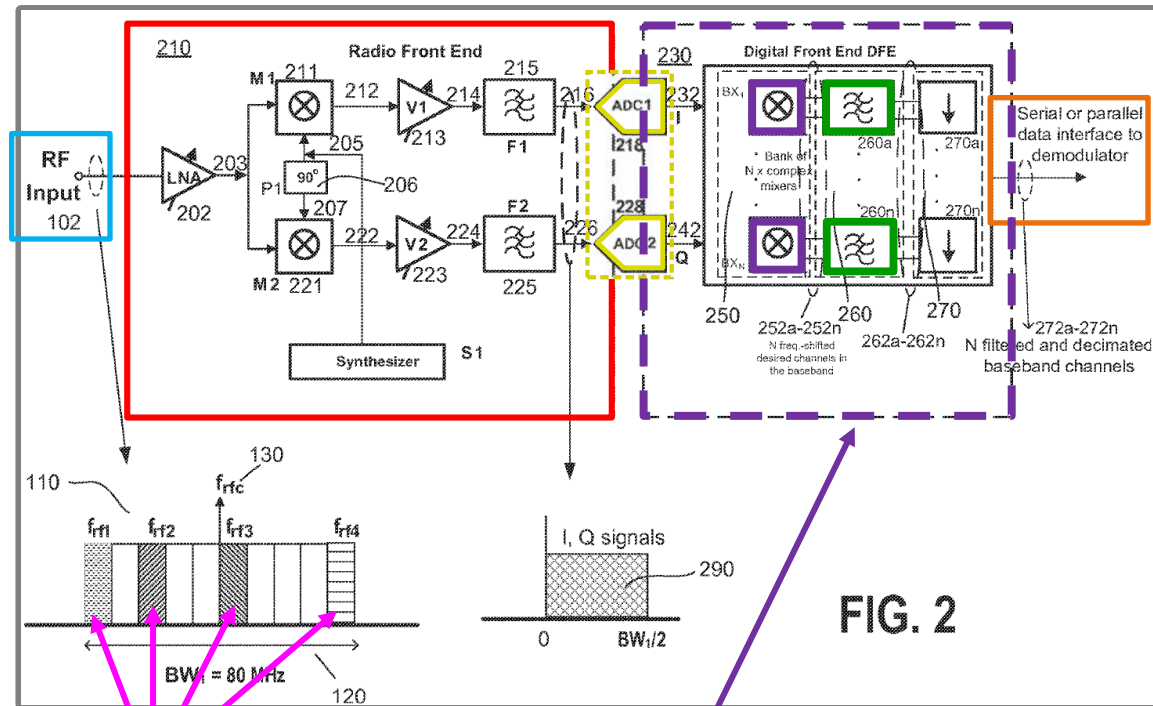


FIG. 2

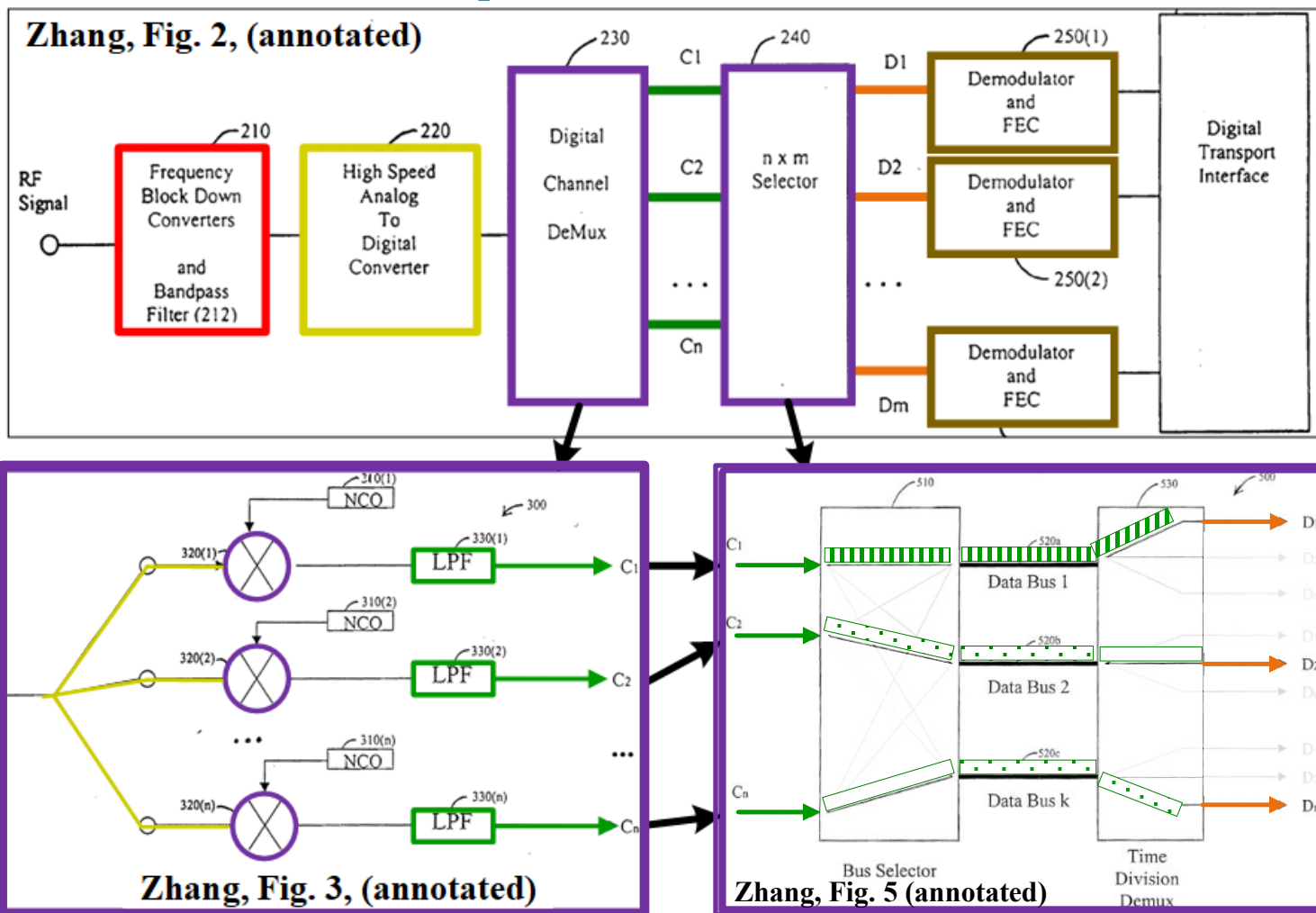
**non-contiguous
desired channels**

main disputed element

**only disputed
for mapping 1**

(Ex. 1001 ('275 Pat.), Fig. 2 (annotated);
Petition, 2-6, 7-9; Ex. 1002 (Lett Dec.), ¶¶ 36-42, 79-82; Reply, 3-7)

Zhang's Circuits Relied Upon for Disclosing the Disputed Elements



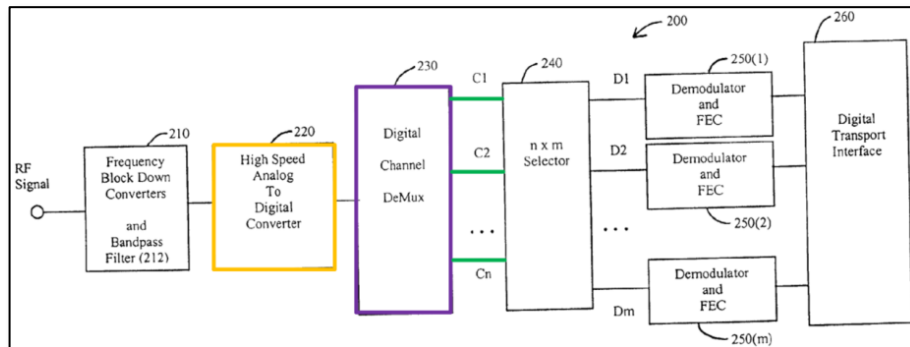
(Reply, 4-5, 9-11; Petition, 31-40; Ex. 1002 (Lett Dec.), ¶¶ 128-156)

The Petition's Two Mappings for the Disputed Elements

In this section above, Zhang's demultiplexer 230 alone was mapped to the claimed "digital frontend (DFE)" and Zhang's target RF channels C_1 - C_n were mapped to the claimed "desired channels." Alternatively, Zhang's demultiplexer 230 in combination with all or part of digital selector 240 is the claimed "digital frontend (DFE)" and Zhang's selected RF channels D_1 - D_m are the claimed "desired channels" (see §VII.A.1.b, *supra*). Ex. 1002, ¶136. The combination of the

(Petition, 33; Ex. 1002 (Lett Dec.), ¶136; Reply, 3-4)

1st Mapping

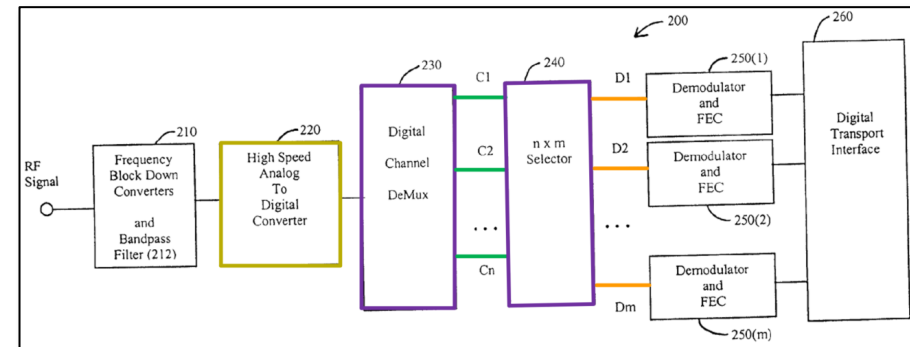


Ex. 1013 (Zhang), Fig. 2 (annotated)

- Zhang's demultiplexer 230 alone = "digital frontend (DFE)"
- Zhang's C_1 - C_n = "desired channels"

(Petition, 31-33; Ex. 1002 (Lett Dec.), ¶¶ 129-136)

2nd Mapping



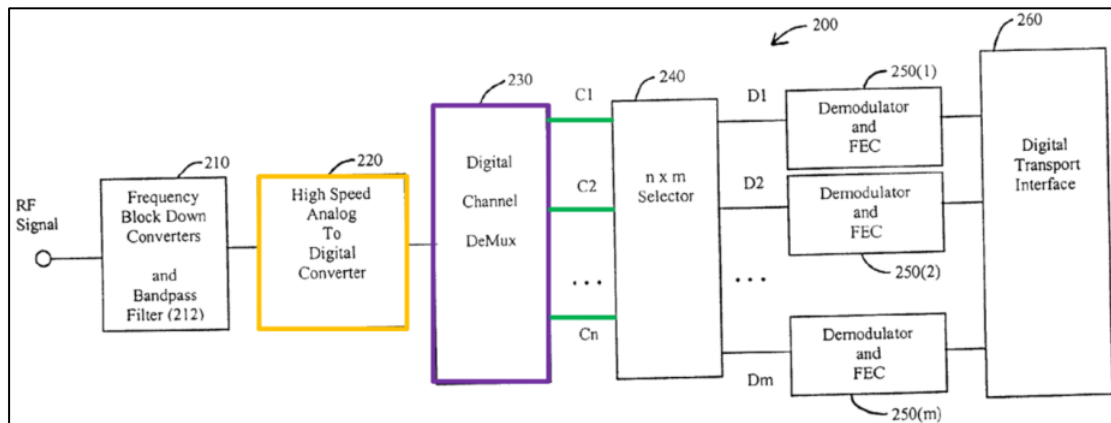
Ex. 1013 (Zhang), Fig. 2 (annotated)

- Zhang's demultiplexer 230 and all or part of selector 240 = "digital frontend (DFE)"
- Zhang's D_1 - D_m = "desired channels"

(Petition, 33-34; Ex. 1002 (Lett Dec.), ¶¶ 136-140)

1st Mapping*: Zhang Teaches Disputed Elements [1E]-[1F]

[1E] selecting, by a digital frontend (DFE) coupled to the ADC, the plurality of desired channels from the digitized signal; and
[1F] outputting, by the DFE, the selected plurality of desired channels to at least one demodulator as a digital datastream, wherein the demodulator extracts information encoded in the digital datastream.



Ex. 1013 (Zhang), Fig. 2 (annotated)

- Zhang's demultiplexer 230 alone = “digital frontend (DFE)”
- Zhang's C1-Cn = “desired channels”

(Petition, 31-33; Ex. 1002 (Lett Dec.), ¶¶ 129-136; Reply, 3-4)

***The Petition's 2nd mapping is discussed below at slide 40.**

Zhang and the '275 Patent Use the Same Structure and Operate in the Same Way for Selecting Desired Channels

[1E] selecting, by a digital frontend (DFE) coupled to the ADC, the plurality of desired channels from the digitized signal; and

[1F] outputting, by the DFE, the selected plurality of desired channels to at least one demodulator as a digital datastream, wherein the demodulator extracts information encoded in the digital datastream.

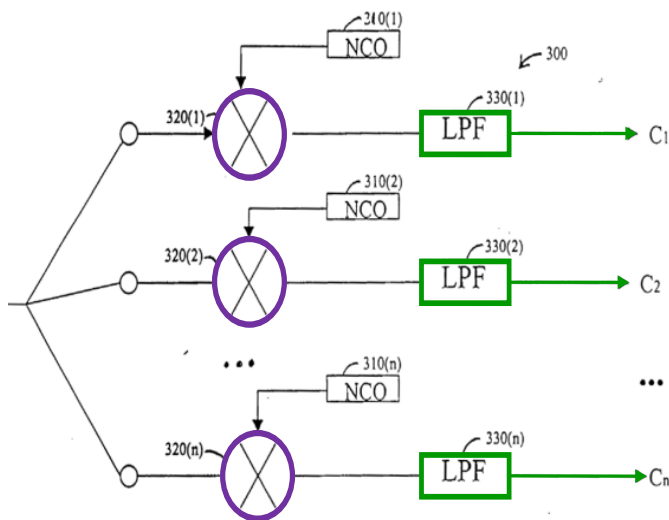
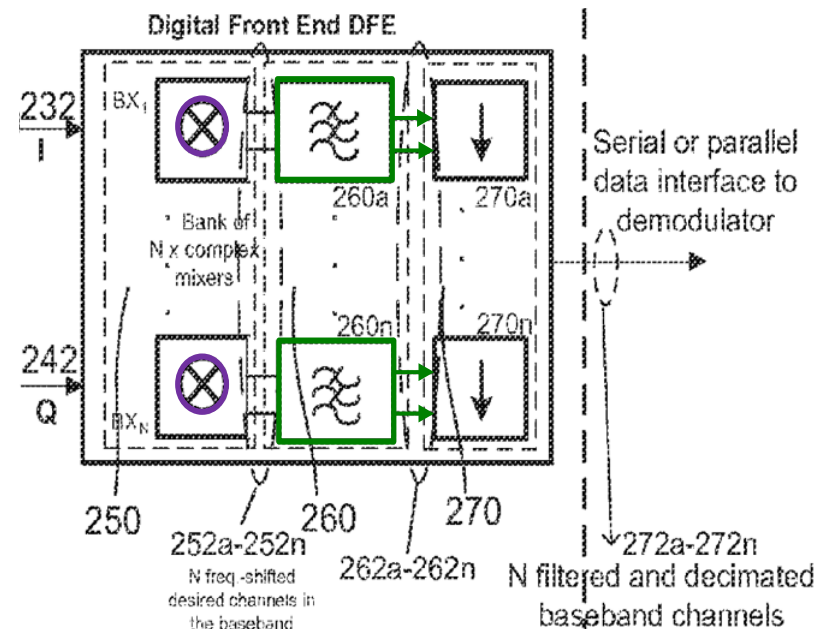


Fig. 3

Zhang, Fig. 3 (annotated)



'275 Patent, Fig. 2 (annotated)

(Petition, 31-33; Ex. 1002 (Lett Dec.), ¶¶ 129-134; Reply, 1, 10-12; Ex. 1085 (Lett Reply Dec.), ¶¶ 6, 31)

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

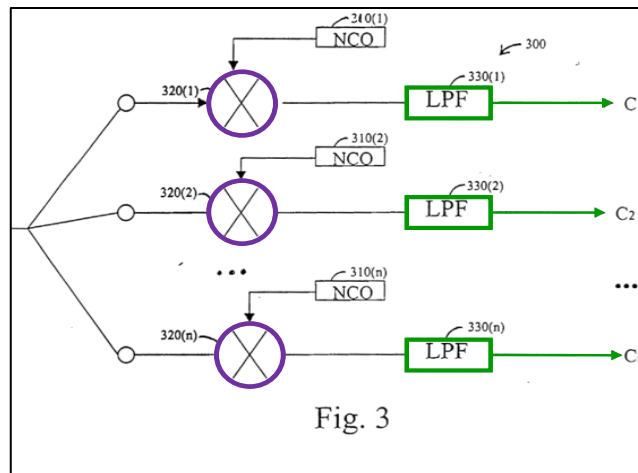
[1E] selecting, by a digital frontend (DFE) coupled to the ADC, the plurality of desired channels from the digitized signal; and

[1F] outputting, by the DFE, the selected plurality of desired channels to at least one demodulator as a digital datastream, wherein the demodulator extracts information encoded in the 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

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



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 a 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), Claim 37

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

(Petition, 31-33; Ex. 1002 (Lett Dec.), ¶¶ 129-134; Reply, 15-19; 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

[1E] selecting, by a digital frontend (DFE) coupled to the ADC, the plurality of desired channels from the digitized signal; and

[1F] outputting, by the DFE, the selected plurality of desired channels to at least one demodulator as a digital datastream, wherein the demodulator extracts information encoded in the 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, [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, 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.

(Petition, 22-26; Ex. 1002 (Lett Dec.), ¶¶ 107-112; Ex. 1013 (Zhang), Cl. 3, [0028]; Reply, 15-16, 25; Ex. 1085 (Lett Reply Dec), ¶¶ 11-12, 26-27, 34)

PO's Argument: Zhang's "desired channel(s)" C₁-C_n Include Undesired Channels

Patent Owner
Argument:

Zhang And Its Prosecution History Expressly Teach That Channels C₁-C_n Are All Channels In The Entire Signal Band, Both Desired And Undesired.

(POR, 15)

But Zhang Teaches:

- Zhang clearly teaches passing only desired RF channels (e.g., selected or used channels) and filtering out undesired RF channels.

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

(Ex. 1013 (Zhang), Claim 37)

(Petition, 22-26, 31-32; Ex. 1002 (Lett Dec.), ¶¶ 130; Ex. 1013 (Zhang), [0028], [0032], Cl. 37; Reply, 15-16; Ex. 1085 (Lett Reply Dec), ¶¶ 11-14)

RF channels C₁ to C_n contain content channels that are selected or used by a subscriber. Channel-search capabilities

(Ex. 1013 (Zhang), [0028])

[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 C₁ to C_n, each RF channel being centered at baseband.

(Ex. 1013 (Zhang), [0032])

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

[1E] selecting, by a digital frontend (DFE) coupled to the ADC, the plurality of desired channels from the digitized signal; and

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 a 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. 2013), ¶ 68

paths, each of which is responsible for extracting one of the channels C_1 - C_n from the digitized input signal. It is in this context that Zhang states that each data path is responsible for extracting its “target channel,” which only means the specific one of channels C_1 - C_n that the data path is responsible for. “Target channel,” thus, does not refer to a “desired” channel but, rather, a particular channel for a particular data path, which may ultimately be desired or undesired. For example, the target channel for the fourth chain is C_4 .

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

(Reply, 15-16; Ex. 1085 (Lett Reply Dec.), ¶¶ 11-12; POR, 25-26)

Patent Owner's Argument That C1-Cn Must Include All Channels is Contrary to Zhang's Claims

[1E] selecting, by a digital frontend (DFE) coupled to the ADC, the plurality of desired channels from the digitized signal; and

- 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 **multi-channel** input.
- Thus, Zhang expressly discloses an embodiment where **C1-Cn** is NOT ALL channels.

Zhang (Ex. 1013), claim 17

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.

Zhang (Ex. 1013), claim 21

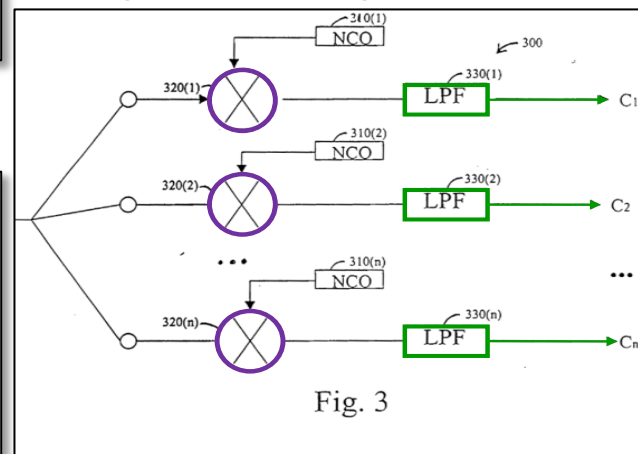
21. A digital tuner for use in multi-channel demodulation, the digital tuner comprising:

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), Fig. 3 (annotated)



(Petition, 32; Reply, 16-17; Ex. 1085 (Lett Reply Dec.), ¶¶ 14-16)

Patent Owner's Argument That C1-Cn Must Include All Channels Ignores Other Zhang Disclosures

[1E] selecting, by a digital frontend (DFE) coupled to the ADC, the plurality of desired channels from the digitized signal; and

- PO ignores that Zhang, like the '275 patent, uses numeric controlled oscillators (NCOs) 310 to “select” target frequencies so C1-Cn are less than all input channels.
- PO ignores that Zhang discloses that the number of multiplier-filter chains depends on the number of channels “to be demultiplexed,” not the number of input channels.

Zhang (Ex. 1013), [0012]

[0012] Other embodiments include a digital tuner for use in multi-channel demodulation. The digital tuner includes a numeric control oscillator (NCO) that generates a select frequency, the select frequency being associated with a corresponding and separate RF channel. A complex multiplier receives the multi-channel digital RF signal and multiplies the multi-channel digital RF signal with the select frequency and passes the result through a low-pass filter LPF to extract the signal that is superimposed on the corresponding RF channel.

Zhang (Ex. 1013), [0030]

[0030] FIG. 3 is a simplified high-level schematic diagram of a digital tuner 300, which in some embodiments of the present invention, can be used to implement digital channel demultiplexer 230 of FIG. 2. 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.

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

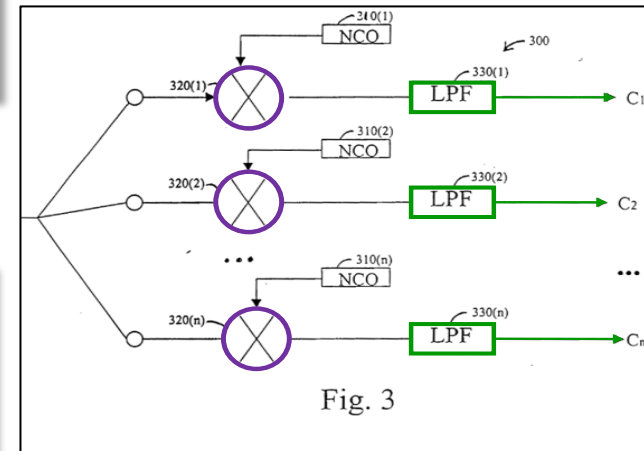


Fig. 3

(Reply, 17-19; Ex. 1085 (Lett Reply Dec.), ¶¶ 17-18)

Patent Owner's Argument That C1-Cn Must Include All Channels Ignores Practical Television Receiver Architectures At the Time

[1E] selecting, by a digital frontend (DFE) coupled to the ADC, the plurality of desired channels from the digitized signal; and

- Typically, a television receiver would have circuitry for simultaneously demultiplexing only a few channels, as a subscriber/user would only watch a few channels simultaneously.

Petitioner's Expert (Mr. Lett) Testimony:

18. Third, the reading of Zhang by Patent Owner and Dr. Russ is unreasonable given practical set top boxes and television receiver architectures at the time of Zhang. For example, a typical television receiver would have circuitry for simultaneously demultiplexing only a few channels (e.g., around 2), as a subscriber/user would only be able to watch a few channels at once anyway. Ex. 1089, 25:16-27:6. As both Zhang and the '275 patent demonstrate, it was known

(Ex. 1085 (Lett Reply Dec.), ¶ 18)

PO's Expert (Dr. Russ) Testimony:

16 Q And you would agree that there are dozens of
17 RF channels carrying those hundreds of television
18 channels; correct?
19 A Yes. My recollection is there were about a
20 120 RF channels carrying those television channels.
21 Q And the set-top boxes you worked on did not
22 simultaneously output all hundred-plus television
23 channels; correct?
24 A They -- the boxes that I worked on would have
25 selected a small number, two, three, or four, maybe six

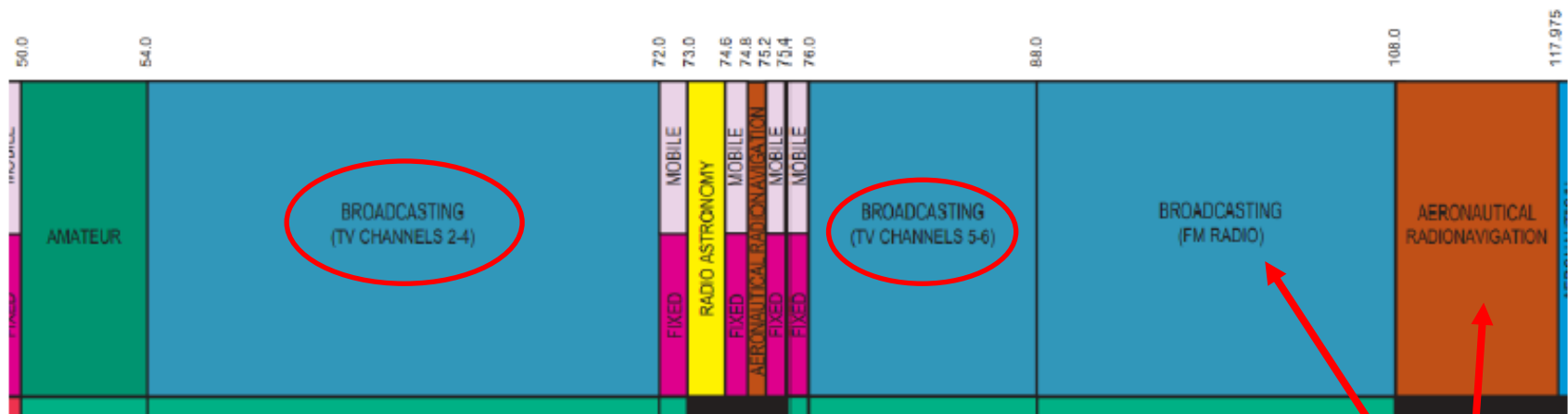
Page 26

1 channels -- television network channels.

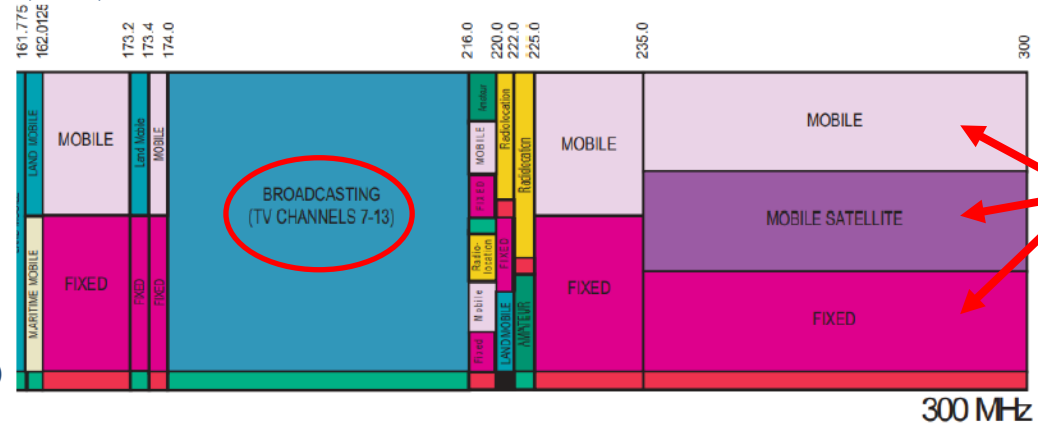
(Ex. 1089 (Russ Depo. Tr.), 25:16-26:1)

Patent Owner's Argument That C1-Cn Must Include All Channels Ignores Practical Television Receiver Architectures At the Time

- It was known that broadcast television channels are spaced at 6 MHz intervals within non-contiguous portions of a frequency spectrum.



(Ex. 1086 (US Freq. Alloc. Chart), 1-2)



undesired channels
(Reply, 18-19, 25-26; Ex. 1085 (Lett Reply Dec.), ¶¶ 18, 21, 34)

(Ex. 1086 (US Freq. Alloc. Chart), 1, 3)

(Reply, 18; Ex. 1085 (Lett Reply Dec.), ¶ 18)

300 MHz

Patent Owner's Argument That C1-Cn Must Include All Channels Ignores Practical Television Receiver Architectures At the Time

- Zhang would not have required demultiplexer 230 to include a multiplier-filter chain for each RF channel – such architecture is impractical because it unreasonably increases costs, power consumption, and heat.

Petitioner's Expert (Mr. Lett) Testimony:

input RF channels starting at 540 MHz. Ex. 1089, 24:18-25:20. A POSITA would have had this background knowledge and would have understood that Zhang's demultiplexer 230 would not have included a multiplier-filter chain for each channel in the input signal. That would have been impractical at least because it would have been unnecessarily expensive and driven up costs and because it would have undesirably increased power consumption and heat. Ex. 1013, [0009], [0028]- (Ex. 1085 (Lett Reply Dec.), ¶ 18)

[0009] The present invention provides a method and circuitry for demodulating signals such as downstream signals. At least some embodiments are characterized by lower cost, lower power consumption, and/or lower complexity.

(Ex. 1013 (Zhang), [0009])

(Reply, 18; Ex. 1085 (Lett Reply Dec.), ¶ 18)

PO's Expert (Dr. Russ) Testimony:

Q And you used the same video tuner for tuning to different portions of the RF spectrum; correct?

A Yes.

Q The reason for using the same video tuner was to reduce cost; correct?

A I would assume so, yes.

Q Scientific Atlanta did not put multiple video tuners in the Explorer 4200 because it wanted to reduce costs; correct?

A Yes. The box was designed with a single video output. So there was no need to spend money on more tuners.

(Ex. 1089 (Russ Depo. Tr.), 38:9-20)

[0044] Embodiments of the present invention can be used in a variety of systems to provide cost-effective, reliable, and power-efficient solutions for home entertainment and information, such as delivering complex VLSI for high-performance video, audio and data content. Also, embodiments of

(Ex. 1013 (Zhang), [0044])

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

[1E] selecting, by a digital frontend (DFE) coupled to the ADC, the plurality of desired channels from the digitized signal; and

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

Patent Owner's Argument:

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. 2013 [Russ-Decl.] ¶ 51.

This is undisputed. Under cross-examination on this point, Petitioner's expert conceded 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. 2019 [Lett-Depo.] 78:14-22.

(POR, 16)

(Reply, 17-18, 20; Ex. 1085 (Lett Reply Dec.), ¶¶ 19-20)

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

[1E] selecting, by a digital frontend (DFE) coupled to the ADC, the plurality of desired channels from the digitized signal; and

- 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 '275 patent, includes non-contiguous channels.

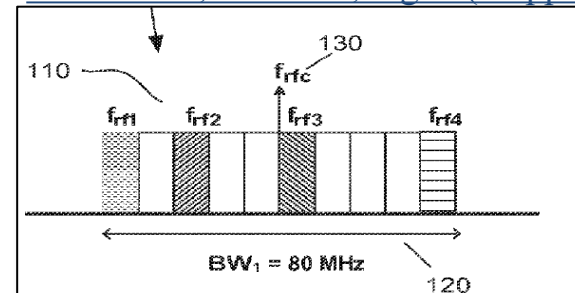
Zhang, Ex. 1013, [0027]

[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.

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



(Reply, 17-18; Ex. 1085 (Lett Reply Dec.), ¶¶ 13, 16)

Zhang and the '275 Patent 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])

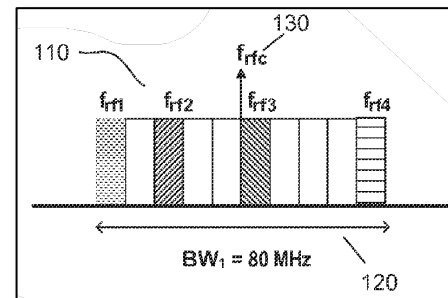
'275 Patent

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, that spectrum

(Ex. 1001 ('275 Patent), 4:43-56)

quency, 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

(Ex. 1001 ('275 Patent), 1:46-48)



(Ex. 1001 ('275 Patent), Fig. 2 (cropped))

(Petition, 23-26; Ex. 1002 (Lett Dec.) ¶¶ 110-113; Reply, 18-19; Ex. 1085 (Lett Reply Dec.), ¶¶ 18, 21)

Zhang's Figure 6 Example Does Not Support PO's Conclusion That C1-Cn Includes All Channels

As Mr. Lett explained, Figure 6 is just an “example”:

in the input signal. See POR, 19-20 (citing Ex. 2022, 44:13-17). However, the Patent Owner conveniently overlooks that I only agreed that was the case “In this specific example.” Ex. 2022, 44:13-17. Zhang clearly indicates that Figure 6 is just one example and never even implies that all channels in the input signal must be demultiplexed. In fact, from Zhang's disclosures that Figure 6 is a “specific embodiment” and that “In other embodiments, the signal can be outside [the 540-750 MHz range],” a POSITA would understand that Zhang is describing examples where the demultiplexer is not demultiplexing all RF channels in the range. Ex. 1013, [0041]. This is also further shown by Zhang's use of “e.g.” when Zhang discloses “e.g., 35 RF channels C1 to C35” and Zhang's statement that “The exact number will depend on the specific application.” Ex. 1013, [0042]. In addition, a POSITA would have understood that by including Figure 2 using ‘n’ for the number of channels C1-Cn in contrast to using C1-C35 in Figure 6, Zhang is disclosing that C1-Cn is a variable number of channels where ‘n’ can be “at least one” which includes a plurality and less than or equal to the number of channels in the RF input signal. Ex. 1013, Claims 21, 37 (“filtering undesired RF channels and passing only the target RF channel”).

(Ex. 1085 (Lett Reply Dec.), ¶ 20)

[0041] FIG. 6 is a simplified high-level block diagram of an exemplary multi-channel demodulator 600 according to another embodiment of the present invention. Demodulator 600 is operates similarly to demodulator 200 of FIG. 2. In this specific embodiment, a frequency-block down-converter 610 receives a multi-channel analog RF signal. This signal can be sourced by a variety of systems such as satellite systems, terrestrial TV systems, cable systems, etc. In this specific embodiment, the signal is sourced by a cable system. Accordingly, the multi-channel analog RF signal is shown to be between 540-750 MHz. In other embodiments, the signal can be outside this range. As shown, the incoming RF signal is split into two signal groups, one in the range of 540-645 MHz and the other in the range of 645-750 MHz. Each group is down converted to a lower frequency band of 20-130 MHz so that the groups can be processed by respective 300-MHz ADCs 620a and 620b.

[0042] ADCs 620a and 620b convert the multi-channel analog RF signals to multi-channel digital RF signals. A demultiplexer 630 demultiplexes the multi-channel digital RF signal into separate digital RF channels C1 to Cn. A single multi-channel RF signal can have multiple separate RF signals, e.g., 35 RF channels C1 to C35 per multi-channel RF signal. The exact number will depend on the specific application. A digital selector 640 digitally selects one or

(Ex. 1013 (Zhang), [0041]-[0042])

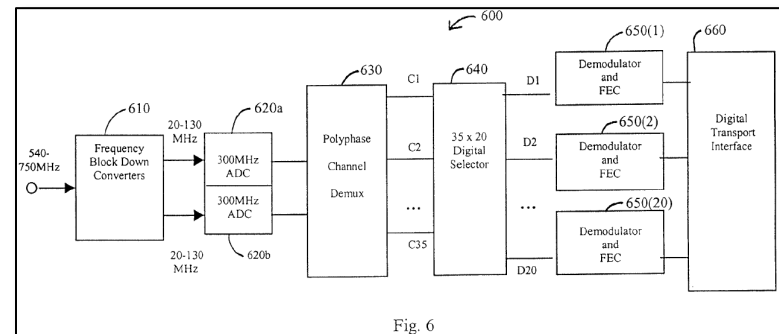


Fig. 6

(Ex. 1013 (Zhang), Fig. 6)

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.
- The additional selection of D1-Dm by selector 240 for fast channel changing says nothing about whether C1-Cn includes undesired channels.
- The Board previously rejected PO's argument relying on the EP prosecution. *See* Ex. 1090, 24-25; Ex. 1091, 30.

POR, 20-21 (citing Ex. 2016, 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).

(Reply, 22; Ex. 1085 (Lett Reply Dec.), ¶ 28)

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

- Selector 240's purpose is to provide fast channel search capabilities (i.e., quickly switch between channels to improve the user experience).
- This does not mean that selector 240 has to select less than all of C1-Cn, nor does it imply that C1-Cn must include all channels in the input signal.
- Where C1-Cn are less than all channels, selector 240 still provides fast switching among those channels.

(Reply, 21)

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

(Zhang, Ex. 1013, [0028])

nificant power savings. Moreover, the RF channel search through a digital selector is much faster than traditional analog channel switch through RF tuners. Moreover, the

(Zhang, Ex. 1013, [0047])

24. Although Dr. Russ cites paragraph 28 of Zhang for stating that selector 240 provides fast channel search capabilities, Dr. Russ wrongly uses that statement to support his argument that “Zhang by design extracts more channels from the input signal than are desired.” Ex. 2013, ¶ 84 (citing Ex. 1013, [0028]). In fact, as explained above, the fast channel search capabilities show that the selector has a separate utility from selecting only desired channels. Indeed, Dr. Russ's deposition testimony confirms that the selector 240 is for providing fast channel changing because it is able to rapidly switch between channels and does not need to wait for the NCOs to settle to new frequencies when a channel is changed. Ex. 1089, 179:1-

(Ex. 1085 (Lett Reply Dec.), ¶ 24)

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

Mr. Lett's Reply Declaration Testimony:

19. 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, 16 (citing Ex. 2019, 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." Ex. 1013, [0027], *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. 2019, 78:2-13, 79:17-80:10, 81:1-20, 83:10-14, 84:11-85:13, 85:24-86:12, 89:5-9. In other words, as I explained in the previous section, a POSITA would have understood that the use of 'n' in paragraph 27 does not define 'n' to be the total number of channels in the entire input signal for use throughout Zhang's specification. Instead, a POSITA would have understood that 'n' retains its normal meaning as a variable representing an integer value of 1 or more.

Ex. 1085 (Lett Reply Dec.), ¶ 19

Ex. 2019 (Prior Lett Depo.), 81:1-10

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

Ex. 2019 (Prior Lett Depo.), 78:2-22

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

(Reply, 20)

It Would Have Been Obvious That Zhang's C1-Cn Do Not Include All Channels

- It would have been obvious that C1-Cn do not include all channels for the same reasons that it would have been obvious that C1-Cn are only the non-contiguous channels that a subscriber selects (or desires).
- A POSITA would have been motivated to design Zhang's demultiplexer 230 to have flexibility to select whichever content channels the subscriber desires.
- A POSITA would have also been motivated to only demultiplex channels that a user is interested in (or subscribed to) to reduce costs by omitting unnecessary multiplier-filter chains for undesired channels.

Further, a POSITA would have been motivated to implement Zhang's system so that the target RF channels C₁-C_n are non-contiguous because it improves the system's flexibility to access content. Ex. 1002, ¶112. A POSITA would not have wanted to be limited to targeting RF channels C₁-C_n within a single frequency band because content would have been (in at least some instances) broadcast in separate frequency bands on non-contiguous RF channels. *Id.* A POSITA would have sought

(Petition, 25; Ex. 1002 (Lett Dec.), ¶ 112)

or subscriber desires. As I previously discussed, a POSITA would have also been motivated to only demultiplex channels that a user or subscriber is interested in or subscribed to in order to reduce costs by omitting unnecessary multiplier-filter chains for undesired channels, and therefore C₁-C_n would have been less than all channels in the analog input signal. Ex. 1002, ¶ 116. In addition, Zhang's demultiplexer 230 would not have targeted channels in the frequencies between the desired television channels C₁-C_n and therefore C₁-C_n would not have included all channels in the analog input signal. Ex. 1086 (U.S. Frequency allocations showing

(Ex. 1085 (Lett Reply Dec.), ¶ 12)

(Reply, 19)

PO Misconstrues “selecting...the plurality of desired channels” to Require “without selecting any undesired channels”

[1E] selecting, by a digital frontend (DFE) coupled to the ADC, the plurality of desired channels from the digitized signal; and

PO’s argument implicitly construes “selecting...the plurality of desired channels” to require a negative limitation of not selecting any undesired channels:

Unlike The '275 Patent, Zhang Extracts All Channels, Both Desired And Undesired, From The Digitized Input Signal Without Any Selection.

(Reply, 2, 22-24; POR, 6)

Problems with PO’s interpretation:

1. Element [1E] 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)

(Reply, 22-24)

PO Misconstrues “selecting...the plurality of desired channels” to Require “without selecting any undesired channels”

[1E] selecting, by a digital frontend (DFE) coupled to the ADC, the plurality of desired channels from the digitized signal; and

3. The '275 Patent discloses embodiments that select all **available** or all **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 '275 Patent selects desired channels “without selecting any undesired channels” is clearly contradicted by the '275 specification.

(Reply, 22-24; Ex. 1085 (Lett Reply Dec.), ¶¶ 30-31)

'275 Patent

tion 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 embodiment, N can be an

(Ex. 1001, 5:56-66)

Patent Owner’s Expert’s Declaration

35. The Figure 2 embodiment of the '275 patent, annotated below, is illustrative. There, the analog input RF signal (yellow) is first digitized in the analog to digital converters (yellow). Ex. 1001 ['275] 5:53-56. Then, a bank of N mixers (blue) selects N desired channels, without selecting any undesired channels, from the digitized input signal. *Id.*, 5:56-61, 6:1-11. Specifically, each of the N mixer paths is responsible for extracting a desired channel from the digitized input signal. The selected desired channels are then output to demodulators (green). *Id.*, 7:16-20.

(POR, 6; Ex. 1013 (Russ Dec.), ¶ 35)

A Plurality of Desired Channels Are Selected As Long As Two Output Paths Include Desired Channels Irrespective of What the Other Paths Include

[1E] selecting, by a digital frontend (DFE) coupled to the ADC, the plurality of desired channels from the digitized signal; and

Element [1E] is met by Zhang when two output paths include desired channels, irrespective of what the other paths include.

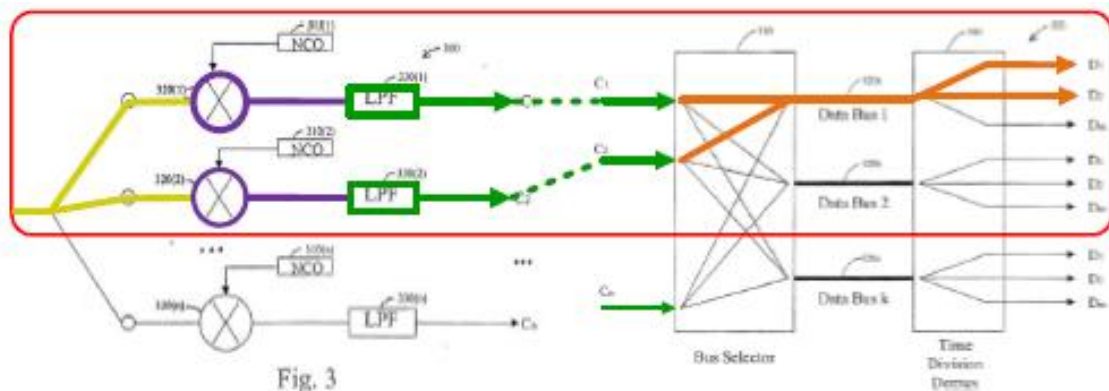


Fig. 3

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

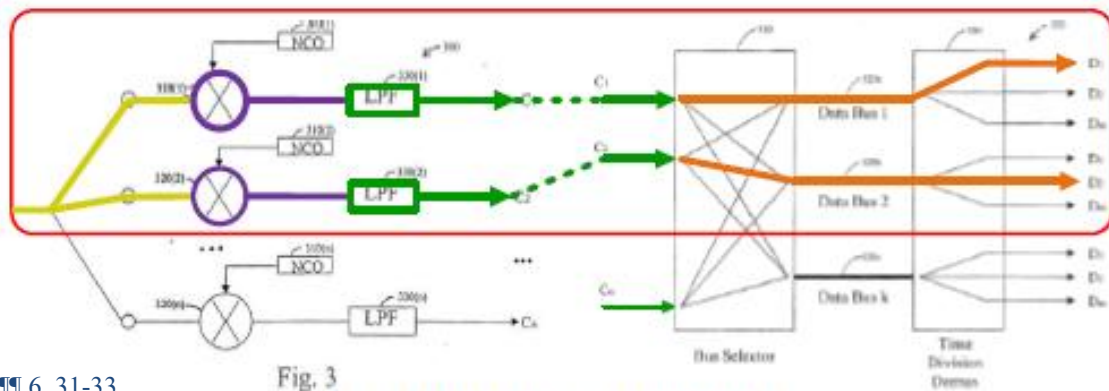


Fig. 3

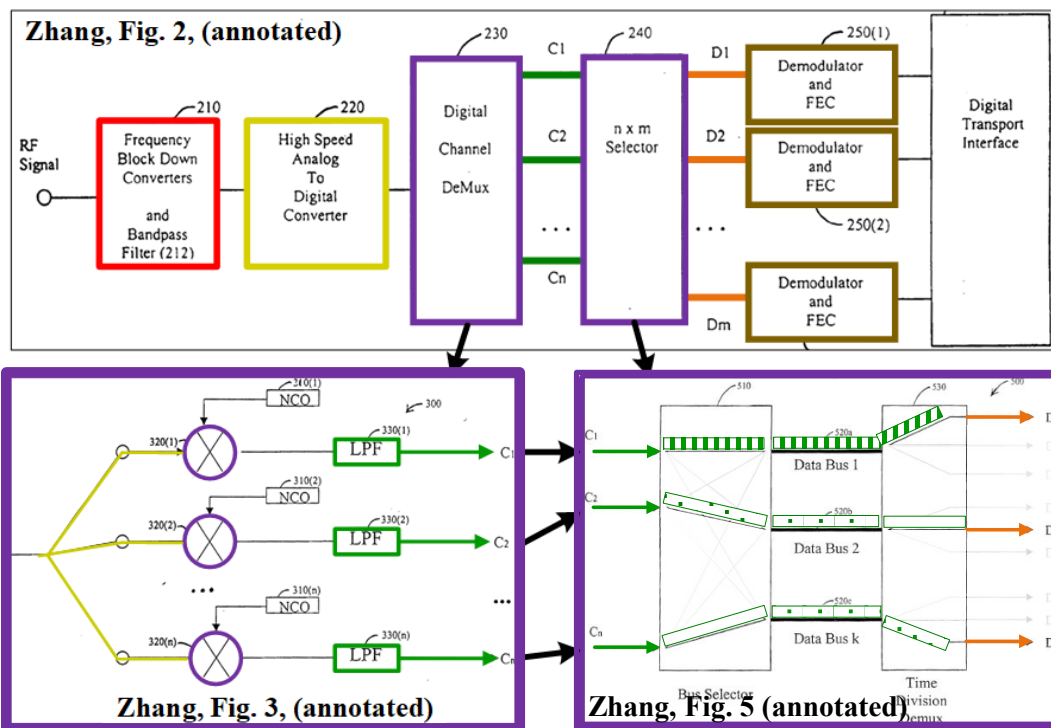
Ex. 1013, Figs. 3, 5 (annotated)

(Reply, 10-11, 24-25; Ex. 1085 (Lett Reply Dec.), ¶¶ 6, 31-33
Ex. 1013 (Zhang), Figs. 3, 5)

Zhang Outputs All of Desired Channels **C1-Cn** To Demodulators

[1E] selecting, by a digital frontend (DFE) coupled to the ADC, the plurality of desired channels from the digitized signal; and

[1F] outputting, by the DFE, the selected plurality of desired channels to at least one demodulator as a digital datastream, wherein the demodulator extracts information encoded in the digital datastream.



All of **C1-Cn** are clearly output as **D1-Dm** when $m=n$.

C1-Cn are also all eventually output when $m < n$.

(Reply, 26; Ex. 1085 (Lett Reply Dec.), ¶¶ 36-37)

PO's "theoretical happenstance" Argument Fails

- Zhang discloses selecting one or more, and thus all, of C_1 - C_n for D_1 - D_m .
- Like 'n,' 'm' is a variable representing 1 or more. Zhang places no limit on 'm,' except that it would not be greater than 'n.' Zhang does not require 'm' to be less than 'n.'
- Thus, $m=n$ is not "theoretical happenstance" (as PO argues), but rather one of the expressly disclosed embodiments in Zhang.

(FIGS. 2 and 3). Still referring to FIG. 2, an $n \times m$ 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 .

(Ex. 1013 (Zhang), [0028])

[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). Because a bus clock is much faster

(Ex. 1013 (Zhang), [0039])

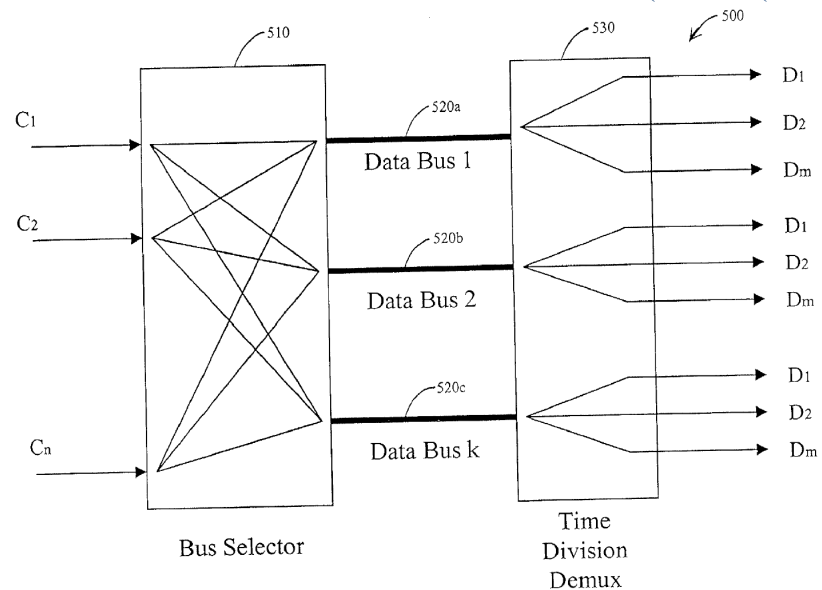


Fig. 5

(Ex. 1013 (Zhang), Fig. 5)

(Reply, 27; Ex. 1085 (Lett Reply Dec.), ¶¶ 36-38)

PO's "theoretical happenstance" Argument Fails

Q In your opinion, in figure five of Zhang, the number of channels C is equal to the number of channels D?

A Yes. Because there's no dot, dot, dots; right. It goes, C1, C2 and and there's no dot, dot, dots up to CM. So this is showing three inputs, three data buses and three outputs.

(Ex. 2031 (Lett Reply Depo. Tr.), 238:3-16)

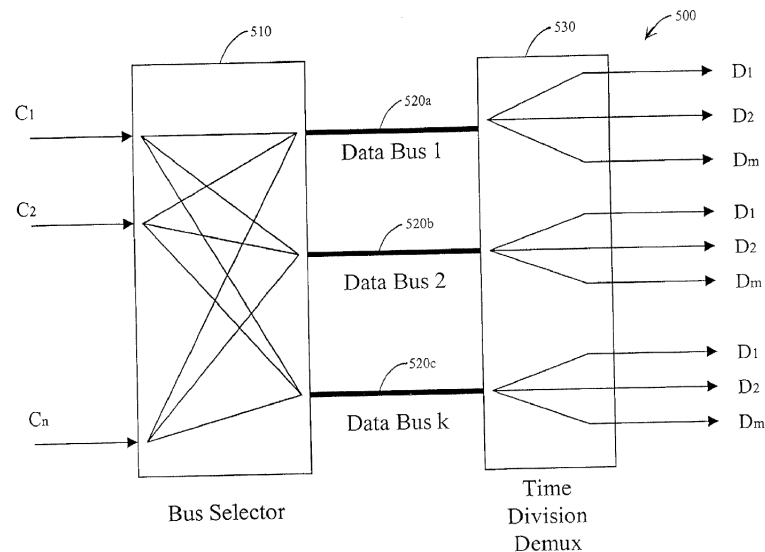


Fig. 5

(Reply, 26-27; Ex. 1085 (Lett Reply Dec.), ¶¶ 36-38)

(Ex. 1013 (Zhang), Fig. 5)

PO's "theoretical happenstance" Argument Fails

PO's Sur-Reply:

FALSE

follow. Zhang's selector exists to choose a subset D_1 - D_m of channels C_1 - C_n for demodulation, not to output all channels C_1 - C_n . Even if Zhang might by happenstance sometimes select all channels C_1 - C_n to be sent to demodulators, it does not disclose a method in which the same plurality of channels that is extracted from the digitized signal is output to demodulators.

(Sur-Reply, 6)

FALSE

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

(Zhang, Ex. 1013, [0028])

nificant power savings. Moreover, the RF channel search through a digital selector is much faster than traditional analog channel switch through RF tuners. Moreover, the

(Zhang, Ex. 1013, [0047])

(FIGS. 2 and 3). Still referring to FIG. 2, an $n \times m$ 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 .

(Ex. 1013 (Zhang), [0028])

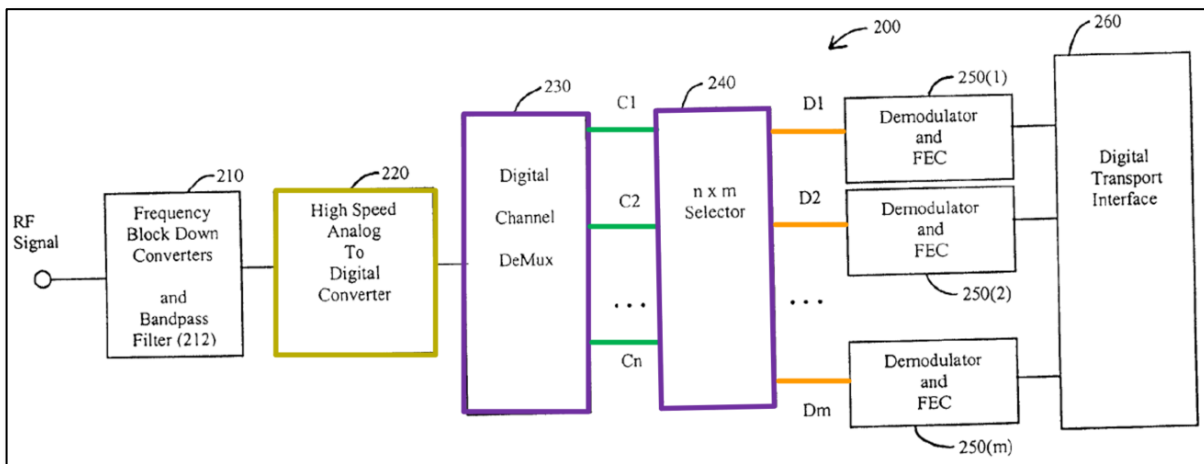
[0039] In operation, digital selector 500 digitally selects one or more RF channels D_1 to D_m from the digital RF channels C_1 to C_n and then sends them to appropriate demodulators or output ports (not shown) through different data buses (not shown). Because a bus clock is much faster

(Ex. 1013 (Zhang), [0039])

(Reply, 11, 21, 27; Ex. 1085 (Lett Reply Dec.), ¶¶ 22-27, 36-38)

2nd Mapping: Zhang Teaches Disputed Elements [1E]-[1F]

[1E] selecting, by a digital frontend (DFE) coupled to the ADC, the plurality of desired channels from the digitized signal; and
[1F] outputting, by the DFE, the selected plurality of desired channels to at least one demodulator as a digital datastream, wherein the demodulator extracts information encoded in the digital datastream.



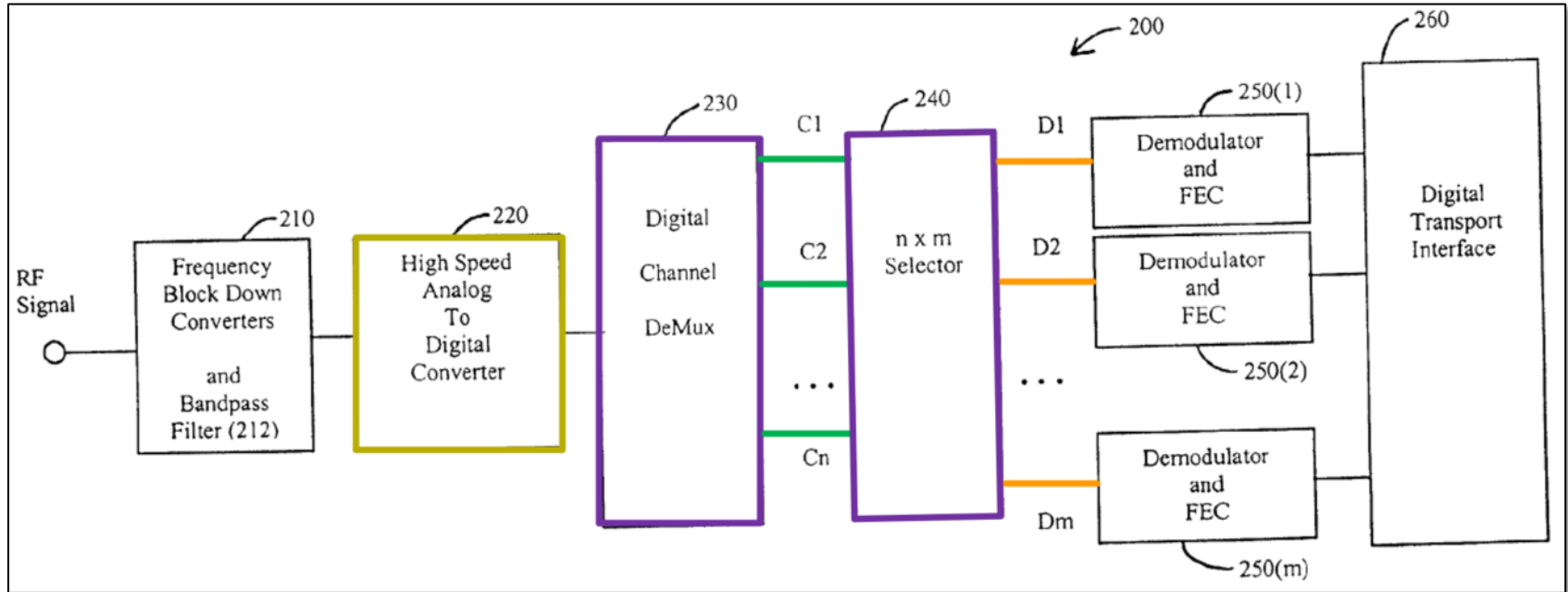
Ex. 1013 (Zhang), Fig. 2 (annotated)

- Zhang's demultiplexer 230 and all or part of selector 240 = “DFE”
- Zhang's D1-Dm = “desired channels”

(Petition, 33-34; Ex. 1002 (Lett Dec.), ¶¶ 136-140; Reply, 4-5)

Patent Owner Admits Zhang's D1-Dm Are “desired channels”

- In mapping 2, Zhang's **D1-Dm** = “desired channels”



(Ex. 1013 (Zhang), Fig. 2 (annotated))

- Patent Owner admits **D1-Dm** are “desired channels” and does not dispute that **D1-Dm** are output to at least one demodulator, meeting [1F]

With respect to channels D_1 - D_m , while they are desired channels, they also fail to disclose the claims for multiple reasons. First, they are not selected “from

(Reply, 4-6)

(POR, 4)

PO's Strawman Argument that Selector 240 Alone is Not the “digital frontend (DFE)” Does Not Address Petitioner's Actual Argument That the Combination of 230 and 240 is the “DFE”

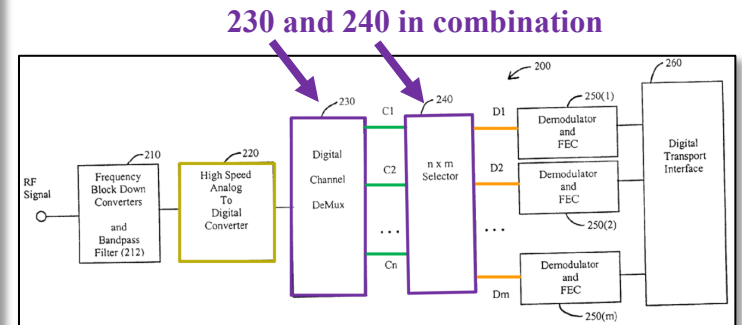
Patent Owner argues that selector 240 alone is not shown to be the “DFE”:

Limitation 1[e] requires that selecting the plurality of desired channels be “by a digital frontend (DFE).” Ex. 1001 [’275] cl. 1. In its alternative theory relying on Zhang channels D_1 - D_m as the claimed “desired channels,” those channels are selected by Zhang’s Selector 240. *See* Section III.B.1, *supra*.
Petitioner, however, fails to show why Zhang’s Selector 240 discloses a “digital front end (DFE)” as claimed.

(POR, 49)

But, the Petition did not assert that 240 alone performs the claimed selection; rather the Petition asserted that Zhang’s **demultiplexer 230 and selector 240 together** are the “DFE”:

In this section above, Zhang’s demultiplexer 230 alone was mapped to the claimed “digital frontend (DFE)” and Zhang’s target RF channels C_1 - C_n were mapped to the claimed “desired channels.” Alternatively, Zhang’s demultiplexer 230 in combination with all or part of digital selector 240 is the claimed “digital frontend (DFE)” and Zhang’s selected RF channels D_1 - D_m are the claimed “desired channels” (*see* §VII.A.1.b, *supra*). Ex. 1002, ¶136. The combination of the



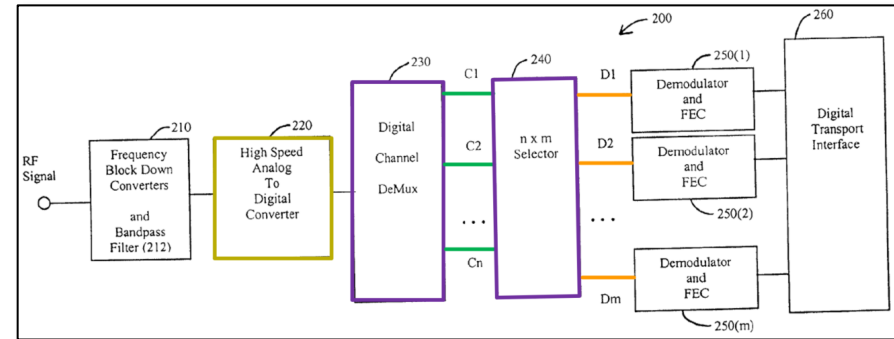
(Reply, 6-8; Petition, 33-34; Zhang (Ex. 1013), Fig. 2)

Zhang's Demultiplexer 230 In Combination With All Or Part Of Selector 240 Discloses The “Digital Frontend (DFE)”

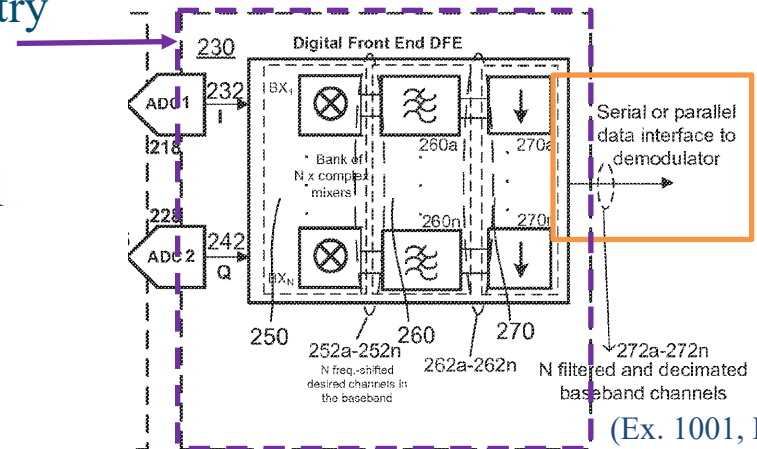
[1E] selecting, by a digital frontend (DFE) coupled to the ADC, the plurality of desired channels from the digitized signal; and

[1F] outputting, by the DFE, the selected plurality of desired channels to at least one demodulator as a digital datastream, wherein the demodulator extracts information encoded in the digital datastream.

- The claims do not prohibit the DFE from including Zhang's selector 240.
- Nor does the specification define “digital frontend” as requiring and/or prohibiting specific structure.
- The '275 merely uses “DFE” to refer to the dashed box drawn around example circuitry situated after its ADC and before its demodulator.
- The '275 Patent's DFE includes the serial or parallel selector, just like Zhang.



(Ex. 1013 (Zhang), Fig. 2 (annotated))



(Ex. 1001, Fig. 2 (cropped))

(Reply, 6-8; Ex. 1085 (Lett Reply Dec.), ¶ 10)

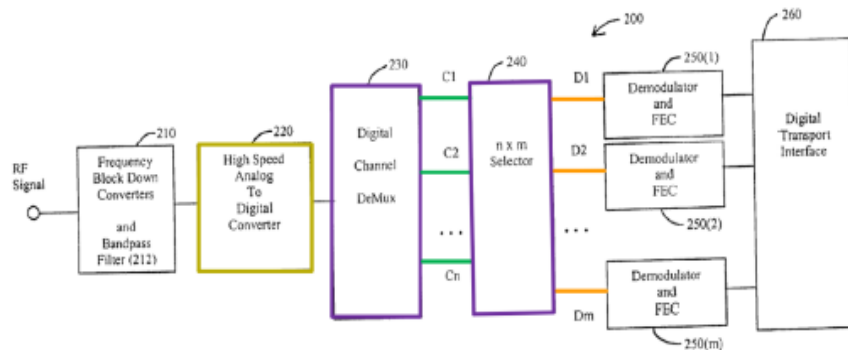
Mapping 2: **D1-Dm** are Selected and Output by the Combination of Zhang's Demultiplexer 230 and Selector 240

[1E] selecting, by a digital frontend (DFE) coupled to the ADC, the plurality of desired channels from the digitized signal; and

[1F] outputting, by the DFE, the selected plurality of desired channels to at least one demodulator as a digital datastream, wherein the demodulator extracts information encoded in the digital datastream.

Petition's 2nd Mapping for [1E]

channels" (see §VII.A.1.b, *supra*). Ex. 1002, ¶136. The combination of the demultiplexer 230 and selector 240 is coupled to ADC 220 and selects (after first selecting target RF channels C_1-C_n) the RF channels D_1-D_m from the multi-channel digital RF signal output by ADC 220:

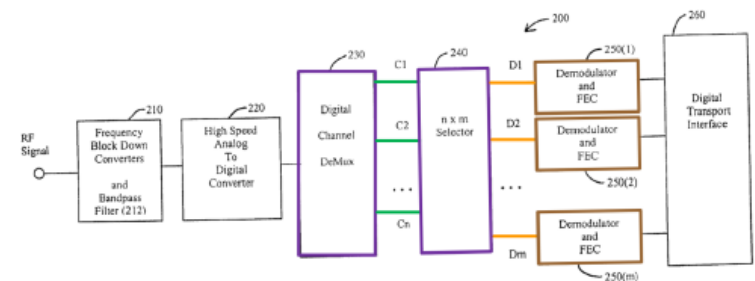


Ex. 1013, Fig. 2 (annotated)

(Petition, 33-34)

Petition's 2nd Mapping for [1F]

Zhang also discloses [1F] with respect to the above-discussed alternative mapping: mapping the combination of demultiplexer 230 and all or part of selector 240 to the claimed "DFE" and selected RF channels D_1-D_m to the claimed "desired channels." Ex. 1002, ¶148. Specifically, Zhang discloses selector 240 (part of the claimed "DFE" in this alternative mapping) outputting the selected RF channels D_1-D_m through data buses as a digital datastream to one or more demodulators 250(1)-250(m):



Ex. 1013, Fig. 2 (annotated)

(Petition, 37)

The Combination of Zhang's Demultiplexer 230 and Selector 240 Receives “the digitized signal” and Outputs Only “desired channels” D1-Dm

[1E] selecting, by a digital frontend (DFE) coupled to the ADC, the plurality of desired channels from the digitized signal; and

[1F] outputting, by the DFE, the selected plurality of desired channels to at least one demodulator as a digital datastream, wherein the demodulator extracts information encoded in the digital datastream.

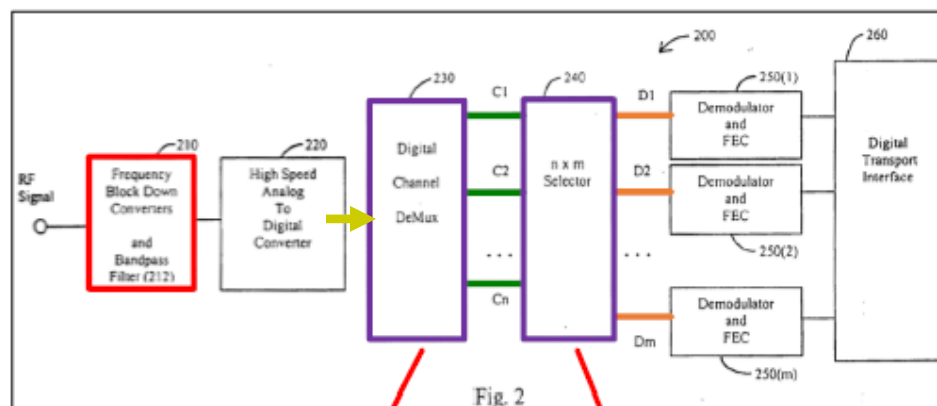


Fig. 2

“desired channels”
D1-Dm

“the digitized signal”

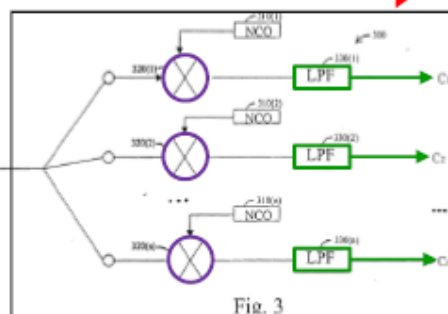
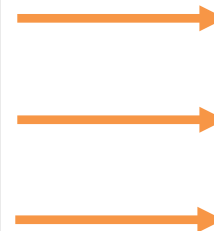
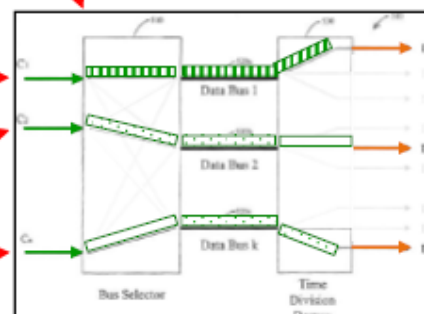


Fig. 3



(Reply, 9-10)

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

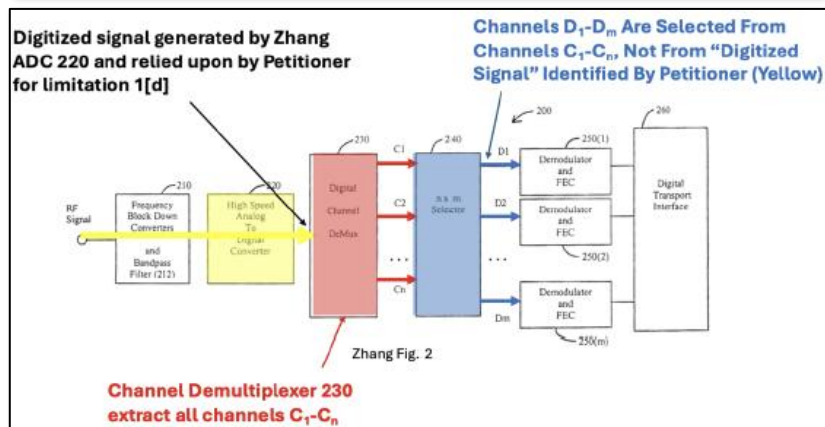
The Combination of Zhang's Demultiplexer 230 and Selector 240 Selects D1-Dm "from the digitized signal"

[1E] selecting, by a digital frontend (DFE) coupled to the ADC, the plurality of desired channels **from the digitized signal**; and

[1F] outputting, by the DFE, the selected plurality of desired channels to at least one demodulator as a digital datastream, wherein the demodulator extracts information encoded in the digital datastream.

Patent Owner argues that D1-Dm are from C1-Cn and not "from the digitized signal"

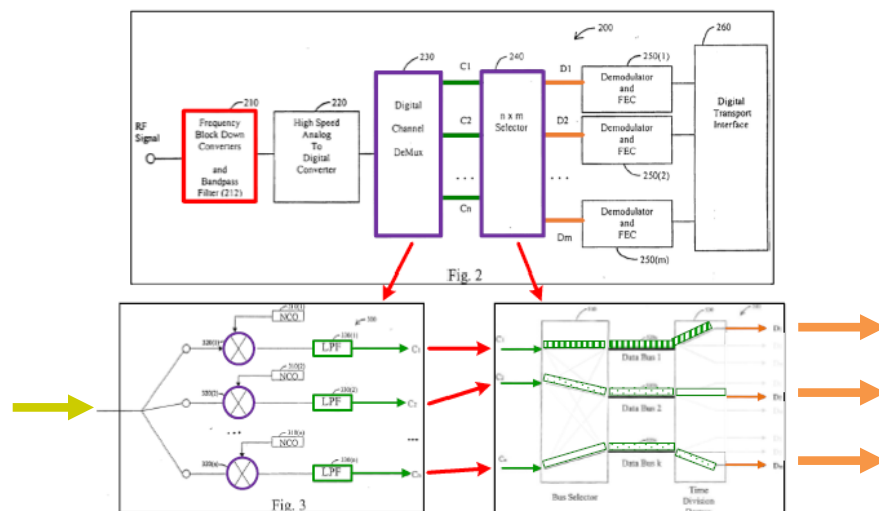
1. Zhang's Channels D₁-D_m Are Not Selected "From The Digitized Signal" As Claimed.



(POR, 39-41)

(Reply, 8-13)

But, Petitioner relies on the combination of 230 and 240 for selecting **D1-Dm** from the **digitized signal** at the input of that combination



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

(Reply, 9-10; Ex. 1013 (Zhang), Figs. 2, 3, 5 (annotated))

Even PO acknowledges that the Board previously disagreed with its argument that Zhang's D1-Dm are not selected from the digitized signal

III. PETITIONER'S MAPPING 2 FAILS BECAUSE ZHANG'S CHANNELS D₁-D_m ARE NOT SELECTED "FROM THE DIGITIZED SIGNAL" AS REQUIRED BY THE CLAIMS.⁴

Petitioner's second mapping for limitation 1[e] relies on Zhang's channels D₁-D_m as the claimed "plurality of desired channels" that are selected by the DFE. As the POR (39-46) explained, this mapping fails because Zhang does not select channels D₁-D_m "from the digitized signal," as the claims expressly require. Instead, Zhang states unambiguously, using the same terminology as the claims,

⁴ The Board previously disagreed with Patent Owner on a potentially similar argument. *See, e.g., Ex. 1092, 25-27.* Patent Owner respectfully disagrees with the Board's decision, which is currently pending review before the Director.

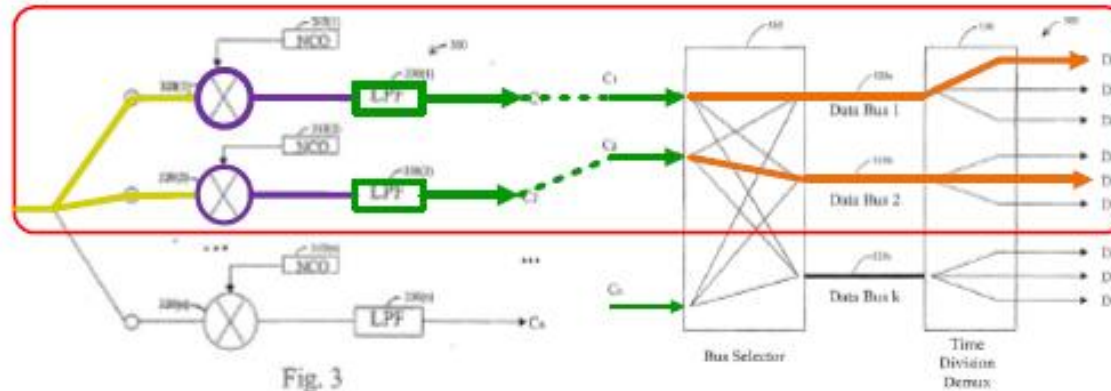
(Sur-Reply, 20 (citing Ex. 1092, 25-27))

Patent Owner contends that Zhang's channels D₁-D_m are selected from channels C₁-C_n and *not* the signal provided by ADC 220. PO Resp. 28. But channels D₁-D_m are based on channels C₁-C_n, which are based on the signal provided by ADC 220. It, therefore, necessarily follows that channels D₁-D_m also are based on the signal provided by ADC 220. In other words, the channels D₁-D_m, which are picked from channels C₁-C_n, are the same channels in both groups, and Patent Owner does not dispute channels C₁-C_n are based on the signal provided by ADC 220. *See Ex. 2023, 60:8-19* (Mr. Lett's deposition testimony from a related case ("[L]et's make C equals to D. . . . C1 is the exact same thing as D1. C2 is the exact same as D2. And so on and so forth. All of those are selected from the input frequencies.")). Petitioner correctly contends, "[n]othing in the claim language prevents the recited 'selecting' . . . from being performed by a digital multiplexer 230 that selects and down converts individual channels from the incoming signal from the ADC in combination with a digital selector 240 that passes certain of those signals along to a demodulator." Pet. Reply 9-10. This understanding is consistent with the

(Ex. 1092 ('206 FWD), 26)

Zhang's "DFE" (demultiplexer 230 with all or part of selector 240) matches the '275 Patent's Figure 2 "DFE"

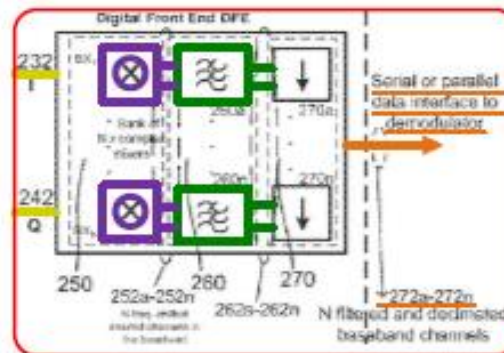
Zhang's DFE receives "the digitized signal"



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

Zhang's DFE outputs "desired channels"

The '275's DFE receives "the digitized signal"



The '275's DFE outputs "desired channels"

(Reply, 10-12; Ex. 1085 (Lett Reply Dec.), ¶ 6)

Prosecution History

Prosecution History of the '275 Patent

- The application that became the '275 patent was rejected only for nonstatutory double patenting based on its parent, which had similar claims but did not include the “non-contiguous” limitation, which the examiner stated was “an obvious condition.”
- After a terminal disclaimer was filed, the application was allowed.
- Reasons for allowance were same as parent (which was also allowed without substantive prosecution): “[t]he prior art made of record do not teach selecting, by a digital frontend (DFE) coupled to the ADC, a plurality of desired channels from the digitized signal and outputting by the DFE, the selected plurality of desired channels to at least one demodulator as a digital datastream.”
- After an RCE and two IDSs to cite litigation documents and references (including the patent of the Zhang reference relied on herein), another notice of allowance was sent and the '275 patent issued.
- There was no discussion of Zhang (in the notice of allowance or elsewhere), and none of Pandey, Zhang '933, Mirabbasi, and Dong were even considered during prosecution.

(Petition, 6-7; Ex. 1002 (Lett Dec.), ¶¶ 43-47)

The Prosecution History Does Not Make The Claims Patentable Over Zhang

- PO misleadingly argues that the examiner “rejected” applying Zhang during prosecution.
- Although the patent that issued from Zhang (“Zhang-Patent”) was cited on an IDS, the examiner never mentioned it, much less distinguished it from the claims.
- The Notice of Allowance merely referenced “Claxton”—not Zhang—and regurgitated elements [1E]-[1F].
- Moreover, the examiner erred by apparently dismissing all the IDS materials, including the Zhang-Patent, as being cited for “other patents, i.e. US 8223,775” involved in Entropic’s litigations.

(Reply, 27-28)

The following is a statement of reasons for the indication of allowable subject matter: the prior art made of record teach a receiver for a wireless telecommunication system teach all of the adjacent frequency bands in the IF signal passed by a band pass filter in the radio frontend are converted to a digital signal by an ADC and then separated into their respective frequency bands by a channelizer where the separated frequency bands are processed in the normal manner by subsequent DSP devices, **see Claxton et al. US 6,735,421**. The prior art made of record do not teach selecting, by a digital frontend (DFE) coupled to the ADC, a plurality of desired channels from the digitized signal and outputting by the DFE, the selected plurality of desired channels to at least one demodulator as a digital datastream.

(Ex. 1004 (Pros. Hist.), 4830; Ex. 1002 (Lett Dec.), ¶ 46)

Claims 19-38 are allowed. The prior art comprising Information Disclosure Statements filed 16 August 2023 and 18 August 2023 was considered by the Examiner in view of the instant application. Although **the prior art is from the applicant’s other patents, i.e. US 8223,775**, as part of Entropic Communications, LLC, the applicant, v. Charter communications, Inc. Civil Action and Entropic Communications, LLC v. DirectTV, LLC and Dish Network Corp., Civil Action, the prior art was related to a cable modem system and architecture but not as claimed in the instant application.

(Ex. 1004 (Pros. Hist.), 4829; Ex. 1002 (Lett Dec.), ¶ 46)

Remaining Combinations Which are Not Disputed

Prior Art Overview

- **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 5, 15 – Use in a digital video recorder (DVR)
 - Claims 7-10, 17-20 – Television channel, satellite or cable broadcast channels
- **Pandey** (Ex. 1014)
 - Claims 2-3, 12-13 – communicating data with serial and parallel interfaces
- **Zhang '933** (Ex. 1077)
 - Claims 2, 12 – using a single demodulator for demodulating multiple RF channels
- **Mirabbasi** (Ex. 1018)
 - Claims 4, 11-15, 17-20 – using in-phase and quadrature structures for analog mixer module, ADCs, and digital mixers
- **Dong** (Ex. 1078)
 - Claims 5-6, 15-16– using digital data for a personal video recorder and a picture-in-picture display

(Petition, 7-14; Ex. 1002 (Lett Dec.), ¶¶ 79-98)

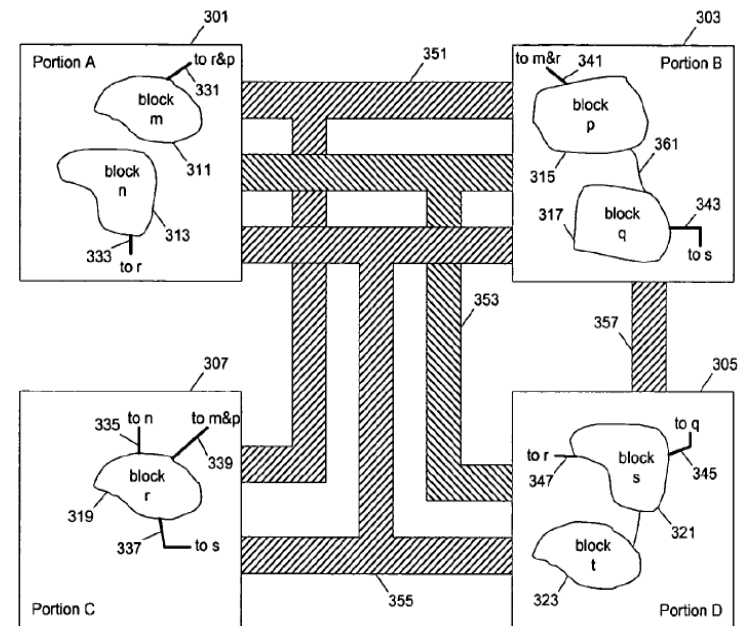
Pandey (U.S. Pat. No. 7,237,214)

- 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;
Petition, 46-47; Ex. 1002 (Lett Dec.), ¶¶ 204-205)

- 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;
Petition, 47-51; Ex. 1002 (Lett Dec.), ¶¶ 206-211)



(Petition, 47;
Ex. 1014 (Pandey), Fig. 3)

Zhang-Pandey

- 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;
Petition, 49-51; Ex. 1002 (Lett Dec.), ¶¶ 208-211)

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

Claims
2, 3, 12, 13

Undisputed

(Petition, 46-51)

Zhang '933 (Int. Pub. No. 2004/059933)

- Zhang '933 describes a multi-channel demodulator with a single **demodulation engine 44** for demodulating multiple RF channels.
- The single **demodulation engine 44** processes the data, from multiple channels, one channel at a time.
- Zhang '933 also teaches a number of serial interfaces (e.g., the single “Data Out” line from Figure 6 showing the FIR filter used in digital tuner 24, or the single line from buffer 30 to channel switch control 40 in Figure 3) along the path for transferring the digital data of the RF channels from digital tuner 24 to **demodulation engine 44**.

(Ex. 1077 (Zhang '933), Abstract, [0006]-[0007], [0009], [0018], [0021]-[0026], [0028]-[0029];
Petition, 11-12, 51-52; Ex. 1002 (Lett Dec.), ¶¶ 88-89, 215-216, 220)

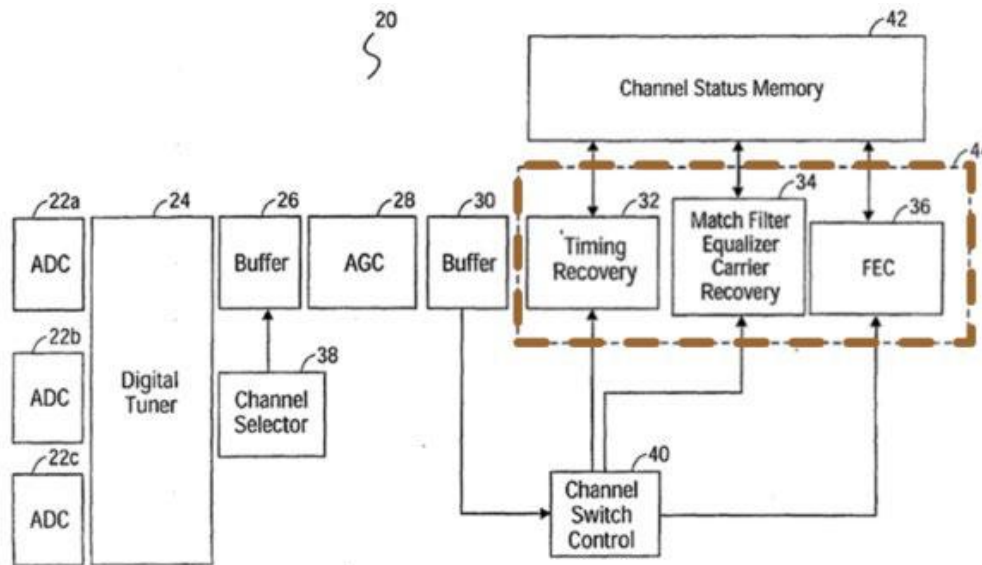


FIG. 3

(Ex. 1077 (Zhang '933), Fig. 3;
Petition, 11; Ex. 1002 (Lett Dec.), ¶ 88)

Zhang-Zhang '933 ('275 IPR)

- A POSITA would have modified Zhang's circuit to use a single demodulator (like Zhang '933's **demodulation engine 44**), instead of Zhang's multiple demodulators 250(1)-(m), to demodulate the selected RF channels D1-Dm.
- For example, it would have been obvious to replace Zhang's multiple demodulators 250(1)-(m) with a single demodulator (like Zhang '933's demodulation engine 44) that demodulates selected RF channels D1-Dm one at a time.
- As part of such combination, a POSITA would have connected Zhang's selector 240 to the single demodulator via a serial interface because a serial interface was a well-known interface for connecting one component to another and a POSITA would have readily recognized it as a solution for feeding the channel data for one channel at a time to the single demodulator.
- A POSITA would have been motivated to carry out the Zhang-Zhang '933 combination to use a single demodulator and serial interface for sending channel data thereto because using a single demodulator (instead of multiple demodulators) and a single-wire serial interface (instead of a multi-wire parallel interface) reduces the amount of circuitry in the system.

(Petition, 52-54; Ex. 1002 (Lett Dec.), ¶¶ 217-220)

- Zhang-Zhang '933 is relied on for the “serial interface” feature recited in the following claims:

Claims
2, 12

Undisputed

(Petition, 51-54; Ex. 1002 (Lett Dec.), ¶¶ 215-220)

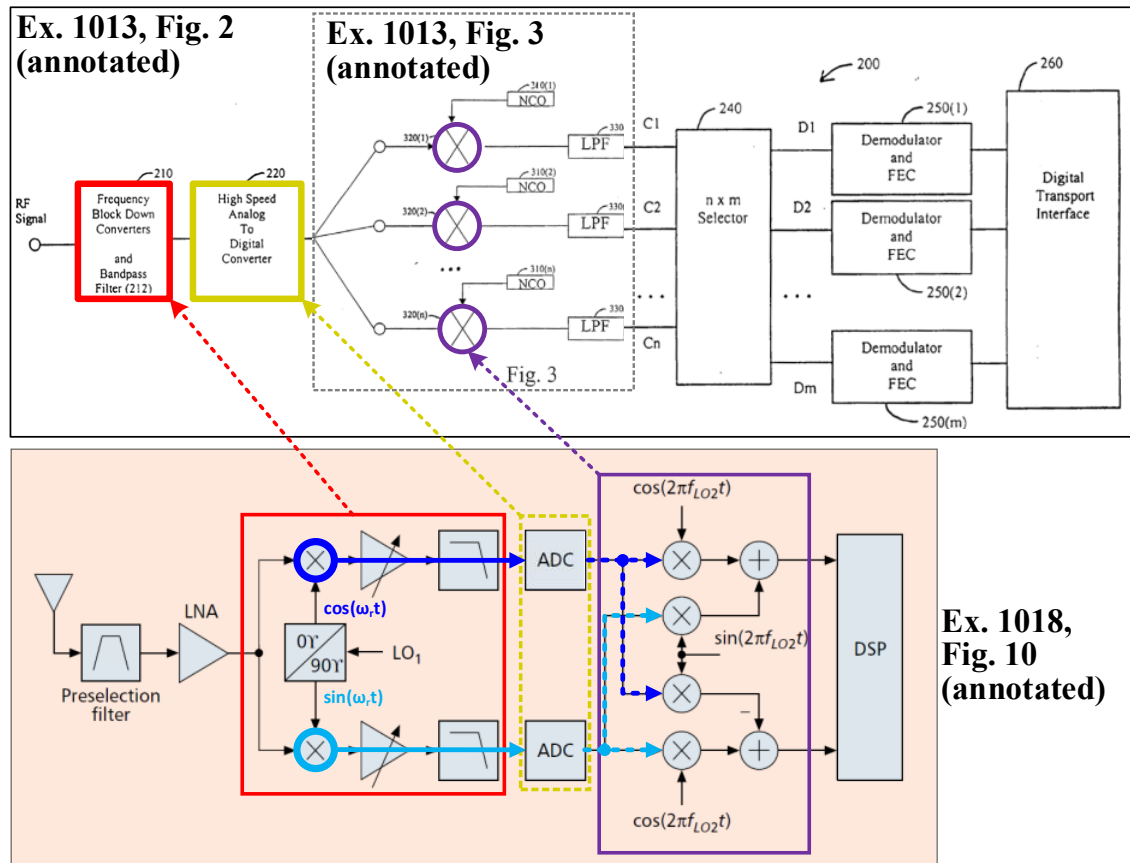
Mirabbasi (“Classical and Modern Receiver Architectures”)

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

(Ex. 1018 (Mirabbasi), 5-6, Fig. 2; Petition, 55-59; Ex. 1002 (Lett Dec.), ¶¶ 224-231)

- 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), 9-10, Fig. 10; Petition, 55-58; Ex. 1002 (Lett Dec.), ¶ 224)



(Ex. 1013 (Zhang), Figs. 2-3; Ex. 1018 (Mirabbasi), Fig. 10; Petition, 56; Ex. 1002 (Lett Dec.), ¶ 224)

Zhang-Mirabbasi

- A POSITA would have been motivated to use Mirabbasi's low-IF design—i.e., its 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), 8-10;
Petition, 56-59; Ex. 1002 (Lett Dec.), ¶¶ 226-231)

- 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., “radio front end” and/or “DFE” if construed as means-plus-function, “in-phase signal” and “quadrature signal” in claim 4) and thus is relied on for the following claims:

Claims
4, 11-15, 17-20

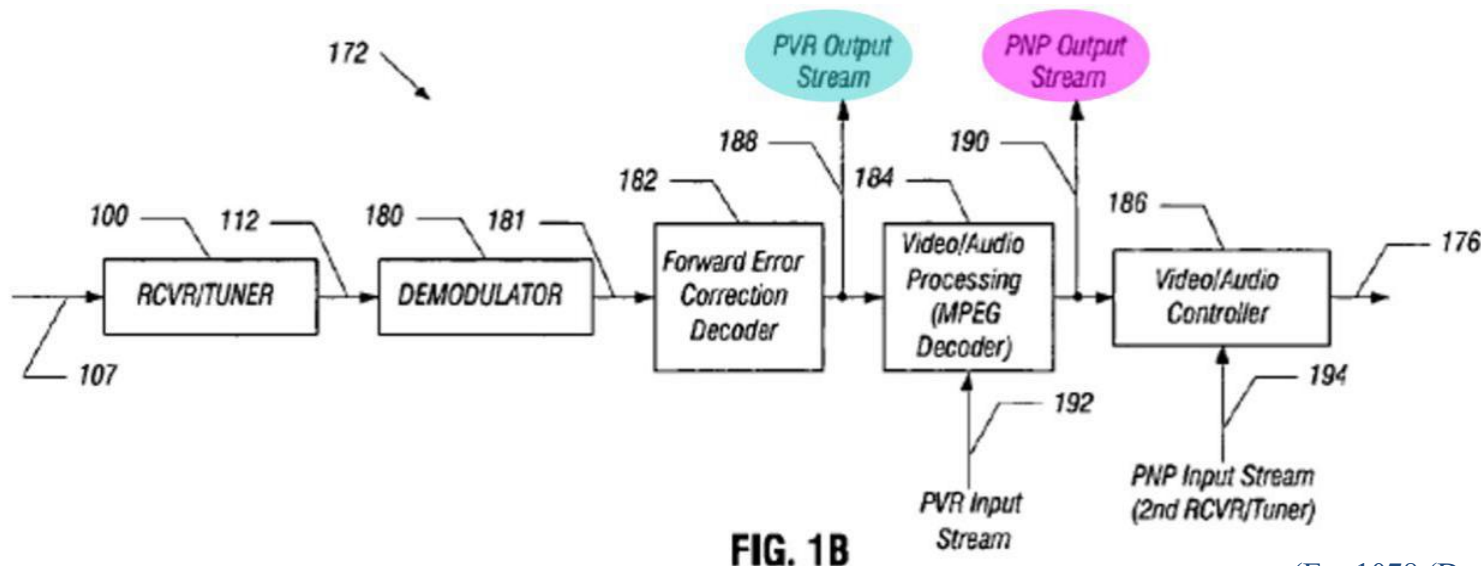
Undisputed

(Petition, 54-59; Ex. 1002 (Lett Dec.), ¶¶ 221-233)

Dong (U.S. Pub. No. 2004/0250284)

- Dong discloses an example architecture in which demodulated digital data is output as a **PVR output stream** for storage in a personal video recorder (PVR) and output as a **PNP output stream** for picture-in-picture (PnP) operations.
- A PVR is another name for (or type of) a DVR.
- Dong teaches storing output(s) of demodulator(s) in a digital video recorder (DVR) and using the output(s) for a picture-in-picture display.

(Ex. 1078 (Dong), [0027], [0082];
Petition, 13-14, 59-60; Ex. 1002 (Lett Dec.), ¶¶ 96-97, 237)



(Ex. 1078 (Dong), Fig. 1B;
Petition, 14; Ex. 1002 (Lett Dec.), ¶ 95)

Zhang-Dong

- A POSITA would have combined Zhang and Dong such that information extracted and output by Zhang's demodulators 250 is stored for use in a DVR (based on Dong's teaching of outputting its PVR output stream for storage in its PVR). For example, it would have been obvious to modify Zhang in view of Dong to store information extracted from channels D1-Dm in a PVR/DVR.
- A POSITA would have been motivated to carry out Zhang-Dong to store the extracted information in a DVR because a POSITA would have wanted to make the information (e.g., content) available at a later time (e.g., for playback of the content after it was broadcasted).
- Storing the extracted information in the DVR gives a subscriber/consumer additional playback features (e.g., rewind, fast-forward, etc.) and the option to access the information one or more times when it is convenient.
- A POSITA also would have been motivated to combine Zhang and Dong such that the information extracted and output by Zhang's demodulators 250 is output for displaying a picture-in-picture feed on a TV, because a POSITA would have wanted to enhance the subscriber's experience.

(Petition, 60-65; Ex. 1002 (Lett Dec.), ¶¶ 217-220, 238-249)

- Zhang-Dong is relied on for the “DVR” and “picture-in-picture” features recited in the following claims:

Claims
5-6, 15-16

Undisputed

(Petition, 59-65; Ex. 1002 (Lett Dec.), ¶¶ 234-250)

Zhang-Mirabbasi-Pandey

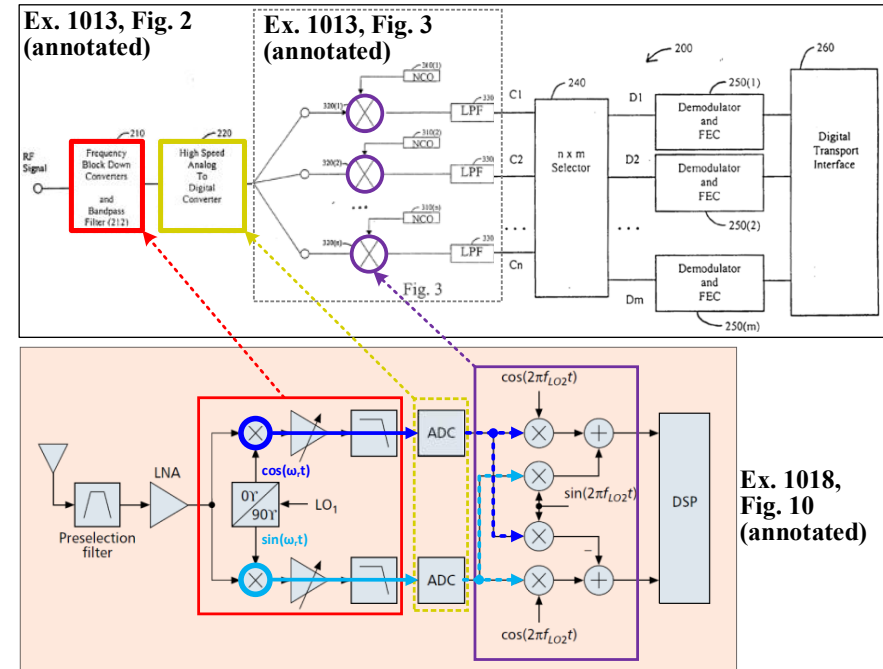
- This ground is relied on to the extent “radio front end” and “DFE” in the independent claims is construed to be a means-plus-function term.
- Zhang-Mirabbasi teaches the same or equivalent structure, with any differences being insubstantial (e.g., multiple parallel paths, each including a complex mixer 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 '275 patent).
- The features added for the “radio front end” and “DFE” to Zhang from Mirabbasi are independent of the Pandey features (e.g., parallel and serial interfaces) added to Zhang.

(Petition, 75-76; Ex. 1002 (Lett Dec.), ¶¶ 270-271)

- Zhang-Mirabbasi-Pandey is relied on for the following claims that recite “via a serial interface” or “via a parallel interface,” if “radio front end” and/or “DFE” invoke means-plus-function:

Claims
12, 13

(Petition, 75-76; Ex. 1002 (Lett Dec.), ¶¶ 270-271)



(Ex. 1013 (Zhang), Figs. 2-3; Ex. 1018 (Mirabbasi), Fig. 10; Petition, 69; Ex. 1002 (Lett Dec.), ¶¶ 260-261)

Undisputed

Zhang-Mirabbasi-Zhang '933

- This ground is relied on to the extent “radio front end” and “DFE” in the independent claims 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 '275 patent).
- The features added for the “radio front end” and “DFE” to Zhang from Mirabbasi are independent of the Zhang '933 features (e.g., serial interface) added to Zhang.

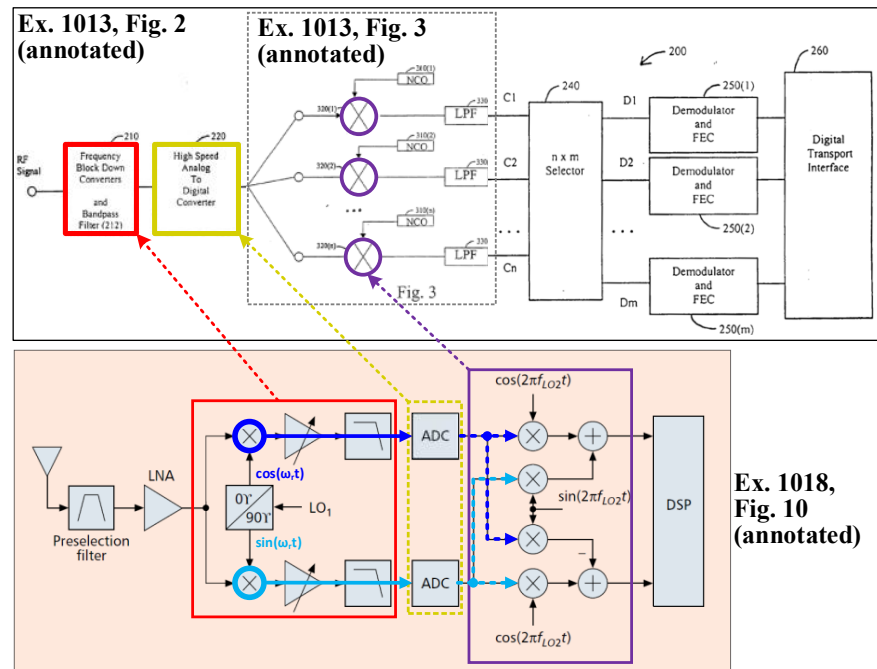
(Petition, 75-76; Ex. 1002 (Lett Dec.), ¶¶ 270-271)

- Zhang-Mirabbasi-Zhang '933 is relied on for the following claim that recites “via a serial interface,” if “radio front end” and/or “DFE” invoke means-plus-function:

Claims
12

Undisputed

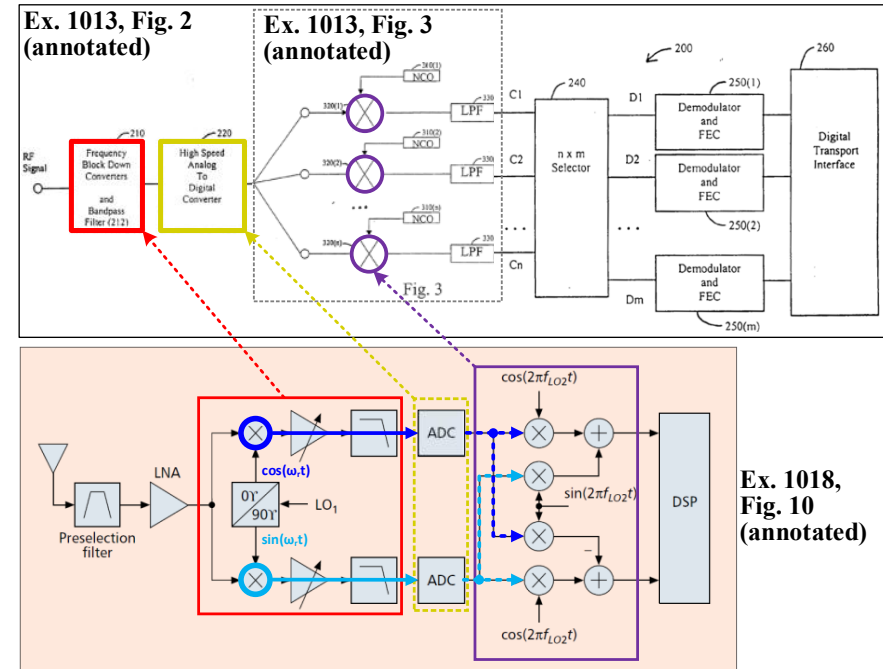
(Petition, 75-76; Ex. 1002 (Lett Dec.), ¶¶ 270-271)



(Ex. 1013 (Zhang), Figs. 2-3; Ex. 1018 (Mirabbasi), Fig. 10; Petition, 69; Ex. 1002 (Lett Dec.), ¶¶ 260-261)

Zhang-Mirabbasi-Dong

- This ground is relied on to the extent “radio front end” and “DFE” in the independent claims 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 '275 patent).
- The features added for the “radio front end” and “DFE” to Zhang from Mirabbasi are independent of the Dong features (e.g., DVR and PnP) added to Zhang. (Petition, 75-76; Ex. 1002 (Lett Dec.), ¶¶ 270-271)



(Ex. 1013 (Zhang), Figs. 2-3; Ex. 1018 (Mirabbasi), Fig. 10; Petition, 69; Ex. 1002 (Lett Dec.), ¶¶ 260-261)

- Zhang-Mirabbasi-Dong is relied on for the following claims that recite “DVR” or “picture-in-picture,” if “radio front end” and/or “DFE” invoke means-plus-function:

Claims
15-16

(Petition, 75-76; Ex. 1002 (Lett Dec.), ¶¶ 270-271)

Undisputed

Overview of the '275 Patent

Overview of '275 Patent's Fig. 2 Embodiment

Four main blocks:

- Radio Front End (**red**)
- Analog to Digital Converters (**gold**)
- Digital Front End (**purple/green**)
- Serial/Parallel Output to Demodulators (**orange**)

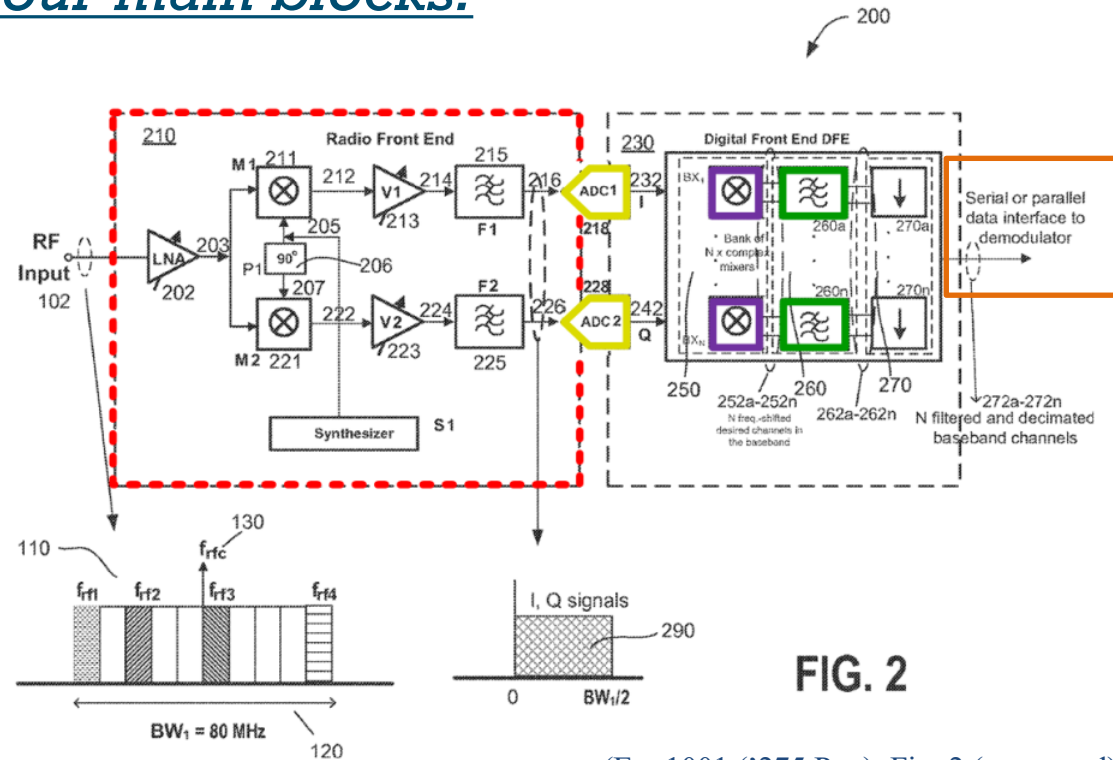


FIG. 2

(Ex. 1001 ('275 Pat.), Fig. 2 (annotated))

(Petition, 2-6; Ex. 1002 (Lett Dec.), ¶¶ 36-42)

Overview of '275 Patent's Fig. 2 Embodiment

Radio Front End (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.

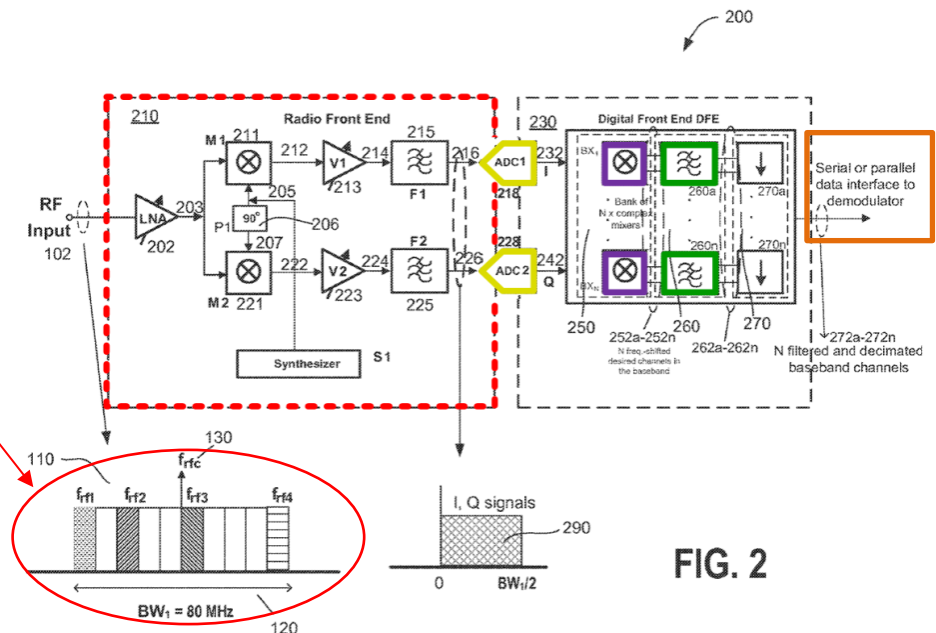


FIG. 2

(Ex. 1001 ('275 Pat.), Fig. 2 (annotated))

(Petition, 2-3; Ex. 1002 (Lett Dec.), ¶¶ 37-38)

Overview of '275 Patent's 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.

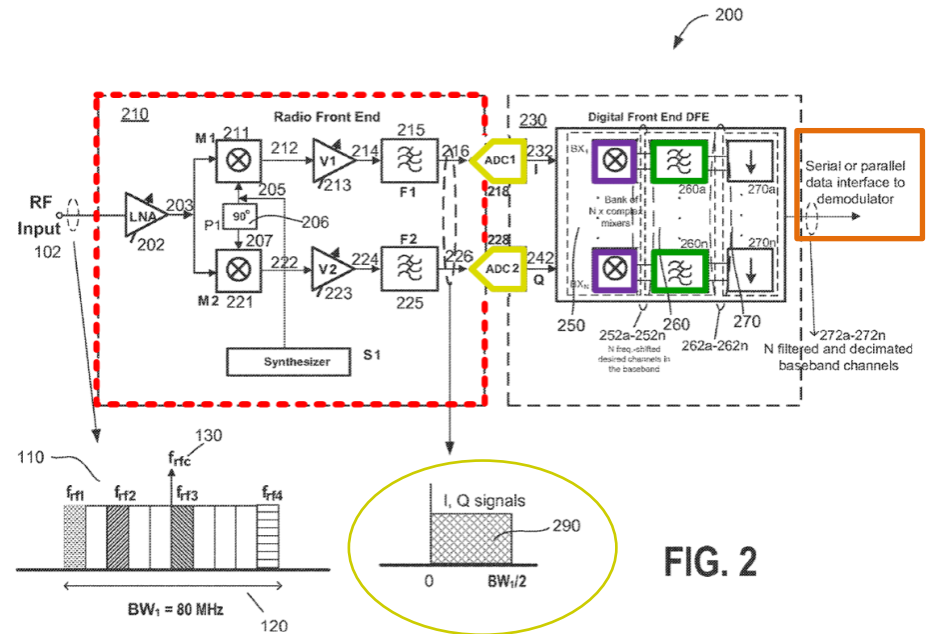


FIG. 2

(Ex. 1001 ('275 Pat.), Fig. 2 (annotated))

(Petition, 3-4; Ex. 1002 (Lett Dec.), ¶ 38)

Overview of '275 Patent's 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, 5:58-59.
- 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.

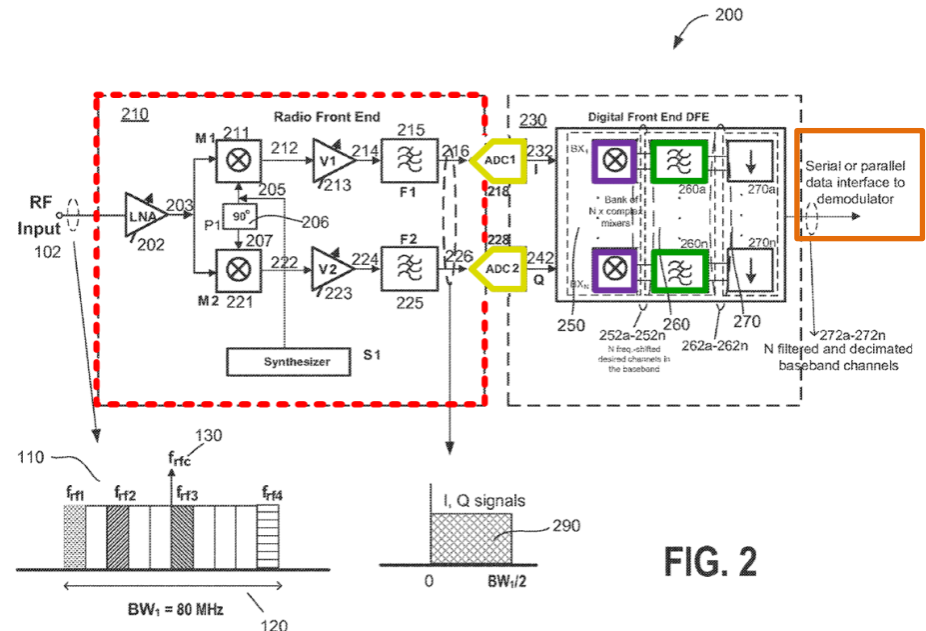


FIG. 2

(Ex. 1001 ('275 Pat.), Fig. 2 (annotated))

(Petition, 3-5; Ex. 1002 (Lett Dec.), ¶¶ 39-41)

Overview of '275 Patent's 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).

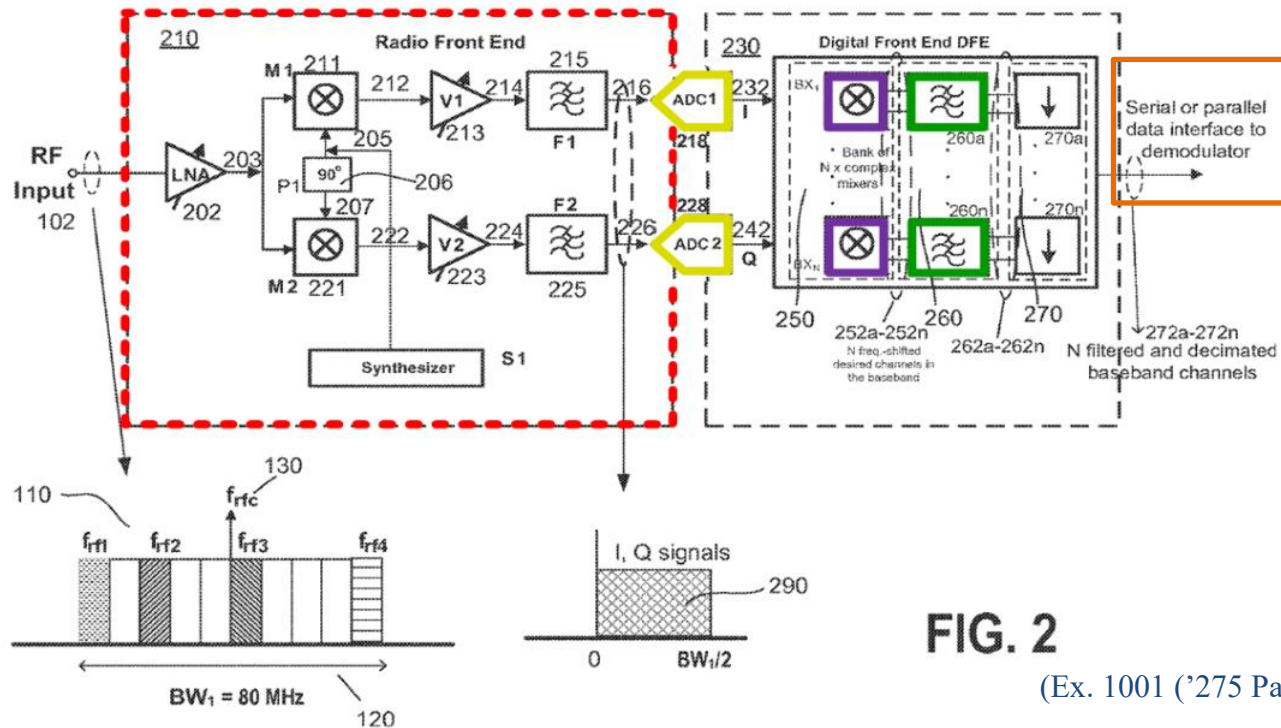


FIG. 2

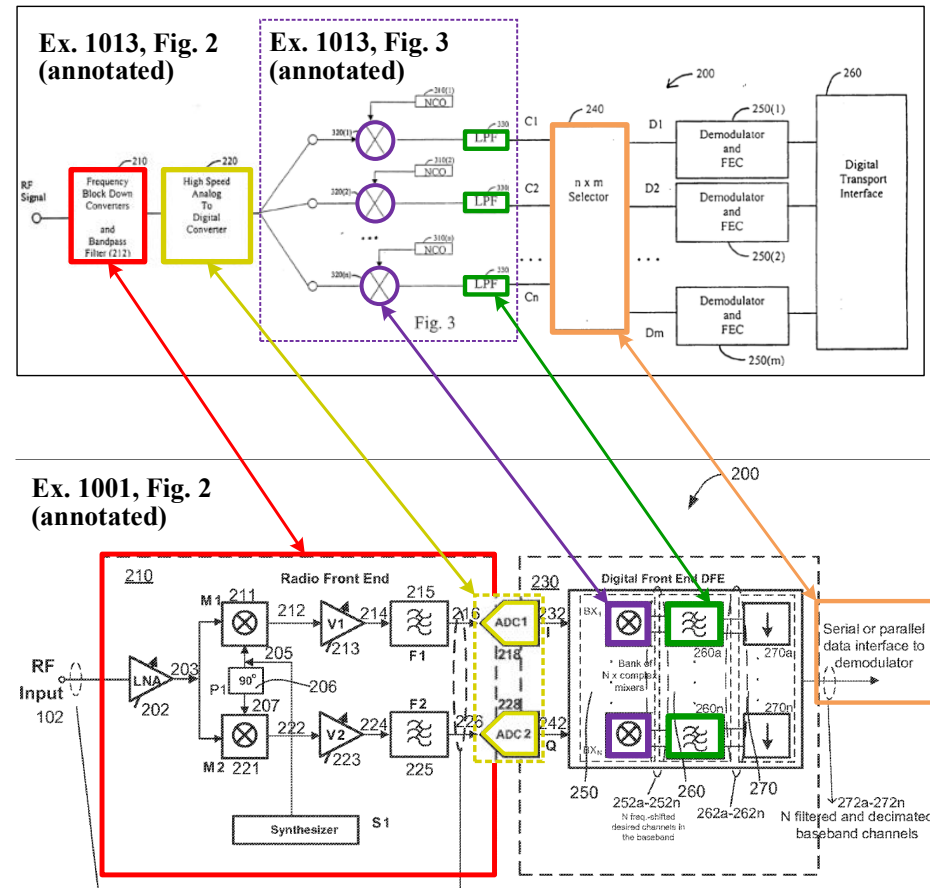
(Ex. 1001 ('275 Pat.), Fig. 2 (annotated))

(Petition, 5-6; Ex. 1002 (Lett Dec.), ¶ 42)

Zhang Mappings for Undisputed Limitations

Comparing Zhang with the '275 Patent

- Zhang and the '275 patent 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 ('275 Pat.), Fig. 2 (annotated);
 Ex. 1013 (Zhang), Figs. 2, 3 (annotated);
 Petition, 7-9; Ex. 1002 (Lett Dec.) ¶¶ 79-82)

Zhang Discloses [1A] (Undisputed Limitation)

[1A] “A method for operating a television receiver, comprising:”

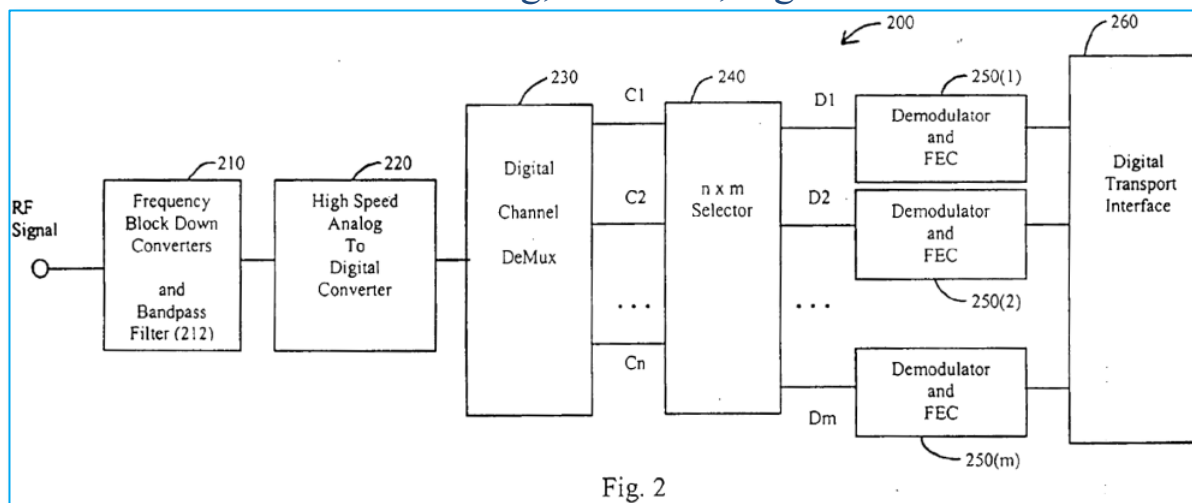
Zhang, Ex. 1013, [0023]

[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, [0004]

[0004] The present invention relates generally to broadband communications, and more particularly to a method and circuitry for implementing demodulator circuits.

Zhang, Ex. 1013, Fig. 2

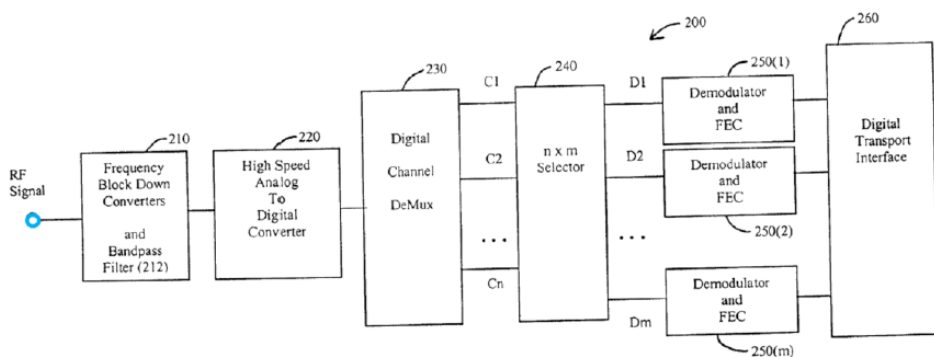


(Petition, 21; Ex. 1002 (Lett Dec.), ¶¶ 101-103; Ex. 1013 (Zhang), [0023], [0004], Fig. 2)

Zhang Discloses [1B] (Undisputed Limitation)

[1B] “receiving, by an input terminal, an input signal comprising broadcast channels, the broadcast channels comprising a plurality of desired channels and a plurality of undesired channels, wherein the plurality of desired channels are non-contiguous;

Zhang’s Figure 2 shows an **input terminal** (claimed “input terminal”) that receives an RF signal (claimed “input signal”):



Ex. 1013, Fig. 2 (annotated)

Zhang, Ex. 1013, [0048]

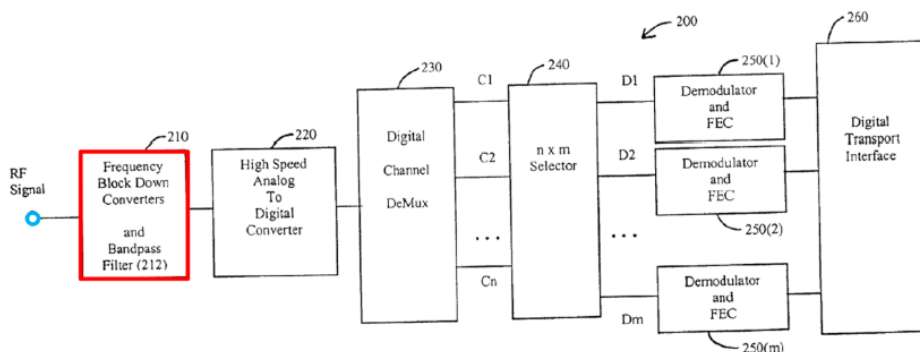
cations, and alternatives. For example, the RF channels can be in different frequency bands. Also, the RF channels need not be contiguous.

(Petition, 22-29; Ex. 1002 (Lett Dec.), ¶¶ 104-120; Ex. 1013 (Zhang), [0048], Fig. 2)

Zhang Discloses [1C] (Undisputed Limitation)

[1C] “processing, by a radio front end coupled to the input terminal, the input signal to generate a processed input signal;”

Zhang discloses **down-converter 210** (claimed “radio front end”) coupled to the **input terminal** (claimed “input terminal”):



Ex. 1013, Fig. 2 (annotated)

Zhang, Ex. 1013, [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 frequency band are then filtered out. The frequencies are lowered so that subsequent stages can better process the signal. For example, in some specific embodiments, the

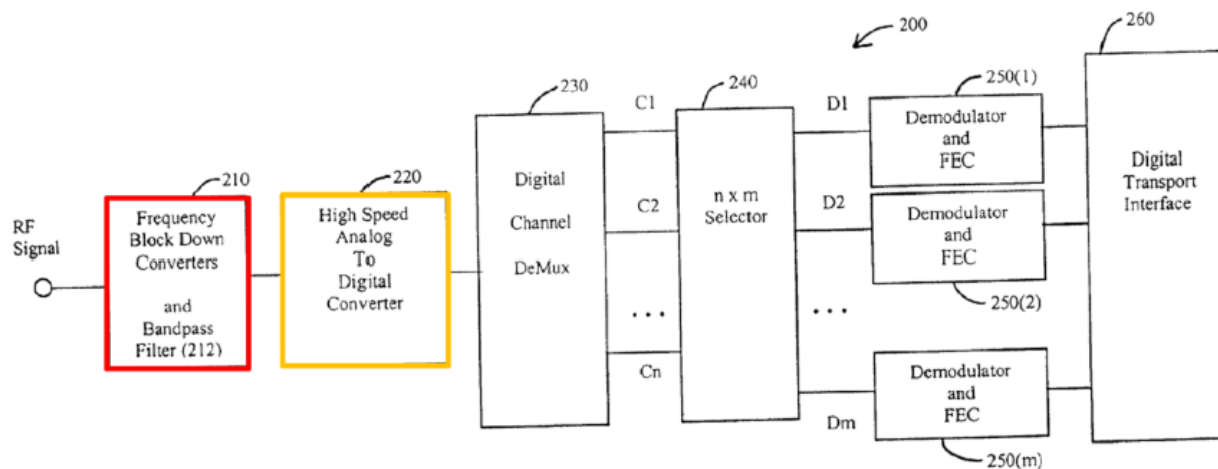
(Petition, 29-30; Ex. 1002 (Lett Dec.), ¶¶ 121-125; Ex. 1013 (Zhang), [0025], Fig. 2)

Zhang Discloses [1D] (Undisputed Limitation)

[1D] “digitizing, by an analog-to-digital converter (ADC) coupled to the radio front end, the processed input signal to generate a digitized signal;”

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.



Ex. 1013, Fig. 2 (annotated)

(Petition, 30-31; Ex. 1002 (Lett Dec.), ¶¶ 126-127; Ex. 1013 (Zhang), [0027], Fig. 2)

Additional Slides

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

PO attempts to use claim differentiation to argue that [1E] requires selecting desired channels *directly* from the digitized signal:

'275 Patent Limitation 1[e]	'866 Patent Limitation 1[b]
“selecting, by a digital frontend (DFE) coupled to the ADC, the plurality of desired channels from the digitized signal”	“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.”

(POR, 46)

(Reply, 13-14)

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.

(Reply, 13-14; POR, 45-47)

Findings from Prior Related IPRs

IPR2024-00432 – all '362 patent claims unpatentable

IPR2024-00435 – all '866 patent claims unpatentable

IPR2024-00438 – all '206 patent claims unpatentable

(Reply, 1; Ex. 1090 ('362 FWD); Ex. 1091 ('866 FWD); Ex. 1092 ('206 FWD))

Notable Findings from Prior IPRs

- Zhang's D1-Dm are selected *from the digitized signal* provided by the ADC 220:

We agree with Petitioner. Limitation 1D recites "select said plurality of desired television channels from said digitized plurality of frequencies." Petitioner contends Zhang's demultiplexer 230 and selector 240 *together* perform the step of claim element 1D. Petitioner identifies the signal provided by Zhang's ADC 220 as the recited digitized plurality of frequencies and Zhang's channels D₁-D_m as the recited digitized plurality of frequencies. Pet. 29, 31-32. As Petitioner's composite figure shows, channels D₁-D_m are selected from the signal provided by ADC 220. Pet. Reply 9; *see also* Ex. 1013, Figs. 2, 3, 5.

Patent Owner contends that Zhang's channels D₁-D_m are selected from channels C₁-C_n and *not* the plurality of frequencies provided by ADC 220. PO Resp. 29. But channels D₁-D_m are based on channels C₁-C_n, which are based on the signal provided by ADC 220. It, therefore, necessarily follows that channels D₁-D_m also are based on the same plurality of frequencies provided by ADC 220. In other words, the channels D₁-D_m, which are picked from channels C₁-C_n, are the same channels in both

groups, and Patent Owner does not dispute channels C₁-C_n are based on the plurality of frequencies provided by ADC 220. Petitioner correctly contends, "[n]othing in the claim language prevents the recited selection from being performed by a digital multiplexer 230 that selects individual channels from the incoming wideband digitized signal in combination with a digital selector 240 that passes certain of those signals along to a demodulator." Pet. Reply 9. This understanding is consistent with the stated objective of the '362 patent because channel selection at the demodulator is still avoided. *See* Ex. 1001, 2:24-27 ("It is desirable to have wideband receiver systems that can increase the dynamic range without requiring . . . channel selection at the demodulator").

(Ex. 1090 ('362 FWD), 28-29)

(Reply, 9 (citing Ex. 1090, 26-29))

Notable Findings from Prior IPRs

- Zhang's demultiplexer 230 alone selects desired channels C₁-C_n
- C₁-C_n are not all channels including undesired channels, as PO argues:

First, channel demultiplexer 230 alone, is described by Zhang as being able to demultiplex the multi-channel digital RF signal received from ADC 220 into separate digital RF channels C₁-C_n. Ex. 1013 ¶ 28. Zhang states expressly that those “RF channels C₁-C_n contain content channels *that are selected or used by a subscriber.*” *Id.* We agree with Petitioner that this evidence discloses, or at least strongly suggests, to a skilled artisan that the configuration of channel demultiplexer 230 allows it to pick out desired content channels from the multi-channel digital RF signal received from ADC 220 to generate RF channels C₁-C_n.

In addition, Zhang teaches an embodiment of channel demultiplexer 230 that generates RF channels C₁-C_n by using a numerical oscillator (NOC) 310 to generate a “target” frequency “that matches the characteristics frequency of a *desired RF channel, or ‘target’ RF channel*” and by using a

low-pass filter (LPF) that “filters out all RF channels *except for its target RF channel*” so that “only the target RF channel passes.” Ex. 1013 ¶ 32. Here, again, we agree with Petitioner that this evidence discloses, or at least strongly suggests, to a skilled artisan that the configuration of channel demultiplexer 230 allows it to pick out desired content channels from the multi-channel digital RF signal received from ADC 220 to generate RF channels C₁-C_n.

(Ex. 1090 ('362 FWD), 23-24)

We agree with Petitioner. Zhang teaches that “RF channels C₁ to C_n contain content channels that are selected or used by a subscriber.” Ex. 1013 ¶ 28. The fact that channels C₁-C_n contain content channels that are “selected” or “used” implies that channels C₁-C_n themselves are desired channels, not both desired and undesired channels. Indeed, as Petitioner points out, Zhang refers to each of channels C₁-C_n as a “desired” channel:

Numeric oscillator 310(1) generates a frequency, or “target” frequency, that matches the characteristic frequency of a *desired RF channel, or “target” RF channel*. . . . Thus, *only the target RF channel passes*. Digital tuner circuit 300 then outputs the *separated RF channels C₁ to C_n*

Id. ¶ 32 (emphases added) (cited by Pet. Reply 5).

(Ex. 1091 ('866 FWD), 18)

(Reply, 14-15)

Notable Findings from Prior IPRs

- Even PO acknowledges that the Board previously disagreed with its argument that Zhang's C_1 - C_n are not all channels in the entire signal band:

II. PETITIONER'S MAPPING 1: CHANNELS C_1 - C_n FAIL TO DISCLOSE THE CLAIMED "DESIRED CHANNELS" EVEN IF THEY WERE NOT ALL CHANNELS IN THE ENTIRE SIGNAL BAND.¹

The claims require "selecting . . . the plurality of desired channels," and "outputting . . . the selected plurality of desired channels to at least one demodulator." Ex. 1001 ['275] 12:35-40. In its first alternative (Mapping 1), Petitioner maps Zhang's channels C_1 - C_n to the claimed "plurality of desired channels." The POR (14-37) showed that Zhang's channels C_1 - C_n are the channels

¹ The Board in earlier proceedings, currently pending review before the Director, found that Zhang's channels C_1 - C_n are not all the channels in the entire signal band. See, e.g., Ex. 1090, 23. Patent Owner respectfully disagrees with that

(Sur-Reply, 1 (citing Ex. 1090, 23))

First, channel demultiplexer 230 alone, is described by Zhang as being able to demultiplex the multi-channel digital RF signal received from ADC 220 into separate digital RF channels C_1 - C_n . Ex. 1013 ¶ 28. Zhang states expressly that those "RF channels C_1 - C_n contain content channels *that are selected or used by a subscriber.*" *Id.* We agree with Petitioner that this evidence discloses, or at least strongly suggests, to a skilled artisan that the configuration of channel demultiplexer 230 allows it to pick out desired content channels from the multi-channel digital RF signal received from ADC 220 to generate RF channels C_1 - C_n .

In addition, Zhang teaches an embodiment of channel demultiplexer 230 that generates RF channels C_1 - C_n by using a numerical oscillator (NOC) 310 to generate a "target" frequency "that matches the characteristics frequency of a desired RF channel, or 'target' RF channel" and by using a

(Ex. 1090 ('362 FWD), 23)

Notable Findings from Prior IPRs

- Zhang's paragraph [0027] does not support PO's position that demultiplexer 230 indiscriminately extracts all channels including undesired channels:

channel" so that "only the target RF channel passes." Ex. 1013 ¶ 32. Here, again, we agree with Petitioner that this evidence discloses, or at least strongly suggests, to a skilled artisan that the configuration of channel demultiplexer 230 allows it to pick out desired content channels from the multi-channel digital RF signal received from ADC 220 to generate RF channels C_1 – C_n .

Patent Owner's contrary arguments do not significantly diminish the weight of Petitioner's evidence. The fact that Zhang describes ADC 220 as "a high-speed ADC so that an entire signal band with n channels can be converted" offers little, if any, support to the notion that Zhang's channel demultiplexer 230 only extracts indiscriminately all channels across the entire signal band. Although we agree with Patent Owner that the above

(Ex. 1090 ('362 FWD), 24)

We note Patent Owner's contention that Zhang's reference to "an entire signal band with n channels" means channels C_1 – C_n include both desired and undesired channels. PO Resp. 12 (citing Ex. 1013 ¶ 27); *id.* at

...

passes."). In the context of Zhang's full disclosure, the reference to "an

entire signal band with n channels" appears to be a reference to a signal band that *includes* the selected (or used) n channels. That is, the signal band could also include unselected (or unused) channels. This reading is further supported by claim 8 of Zhang, which recites "the ADC converts an entire signal band, the signal band including the multichannel analog RF signal." *Id.*, claim 8 (cited by Pet. 21–22).

(Ex. 1091 ('866 FWD), 29-30)

(Reply, 17-18)