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PROVISIONAL

PATENT APPLICATION

WIDEBAND TUNER ARCHITECTURE

Inventors: Madhukar Reddy, a citizen of The United States, residing at
2011 Palomar Airport Road, Suite 305
Carlsbad, CA 92011

Curtis Ling, a citizen of The United States, residing at
3667 Adams Street
Carlsbad, CA 92008

Assignee: MaxLinear, Inc.
2011 Palomar Airport Road, Suite 305
Carlsbad, CA 92011

Entity: Small business concern

TOWNSEND and TOWNSEND and CREW LLP
Two Embarcadero Center, Eighth Floor
San Francisco, California 94111-3834
Tel: 650-326-2400

WIDEBAND TUNER ARCHITECTURE

Madhukar Reddy, Curtis Ling

1. OVERVIEW

This invention is related to a method and apparatus for receiving several channels located in discontinguous portions of a frequency spectrum, and downconverting them in such a way that when combined, they form a contiguous group of channels at a much lower intermediate frequency (IF). One of the applications this invention targets is the reception of television channels being transmitted on a cable. These channels are distributed across a wide range of frequencies. For data transmission, the standard requires the simultaneous reception of several channels at once; these channels may not be contiguous.

1.1 BACKGROUND INFORMATION

The receivers used to downconvert and selectively filter TV channels are referred to as *tuners,* and tuners designed to simultaneously receive several TV channels are referred to as *wideband tuners*. Existing tuners for these applications downconvert a *swath* of channels to an intermediate frequency which are then sent to a demodulator. Because the desired channels are not contiguous, this swath includes the desired channels as well as undesired channels. The demodulator employs a high-speed data converter to capture this swath of desired and undesired channels in the digital domain and subsequently filter out the desired channels. A typical implementation is show below

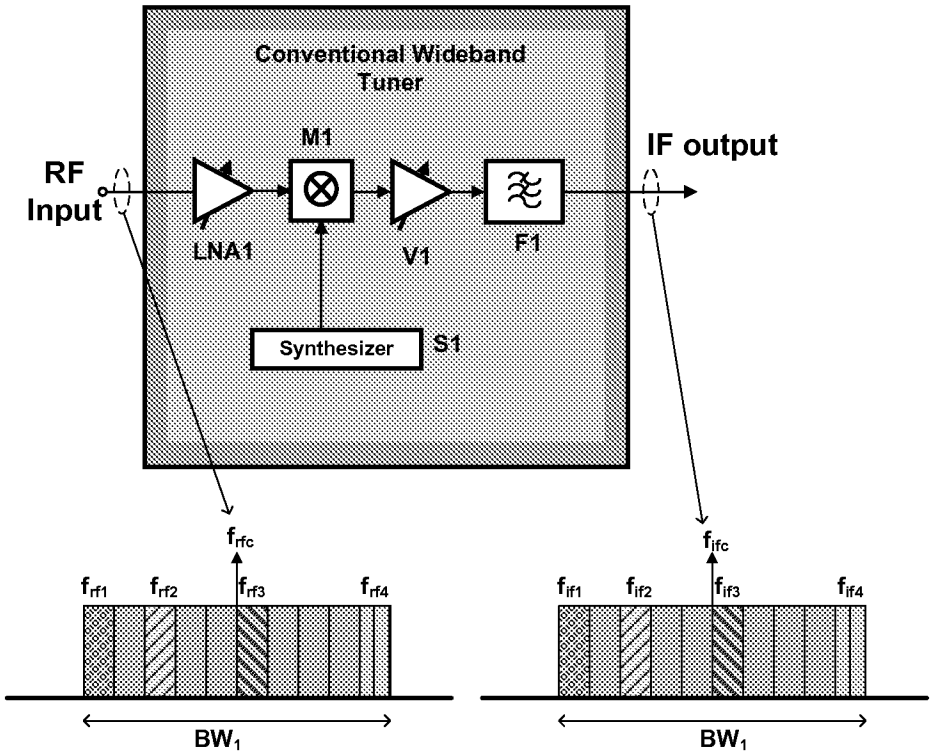

Figure 1. Illustration of frequency conversion using a conventional wideband tuner

Referring to Figure 1, the swath of channels occupies a bandwidth BW1 at an RF center frequency f_{rfc}. The synthesizer S1 is tuned to mix the channels to a center frequency f_{ifc}, which are amplified and filtered by V1 and F1 respectively. Bandwidth BW1 typically contains 10 to 15 channels, or 60-100MHz, of which only four are desired. This requires that the IF frequency f_{ifc} be at least BW1/2, or about 50MHz.

2. DETAILED DESCRIPTION OF THE INVENTION

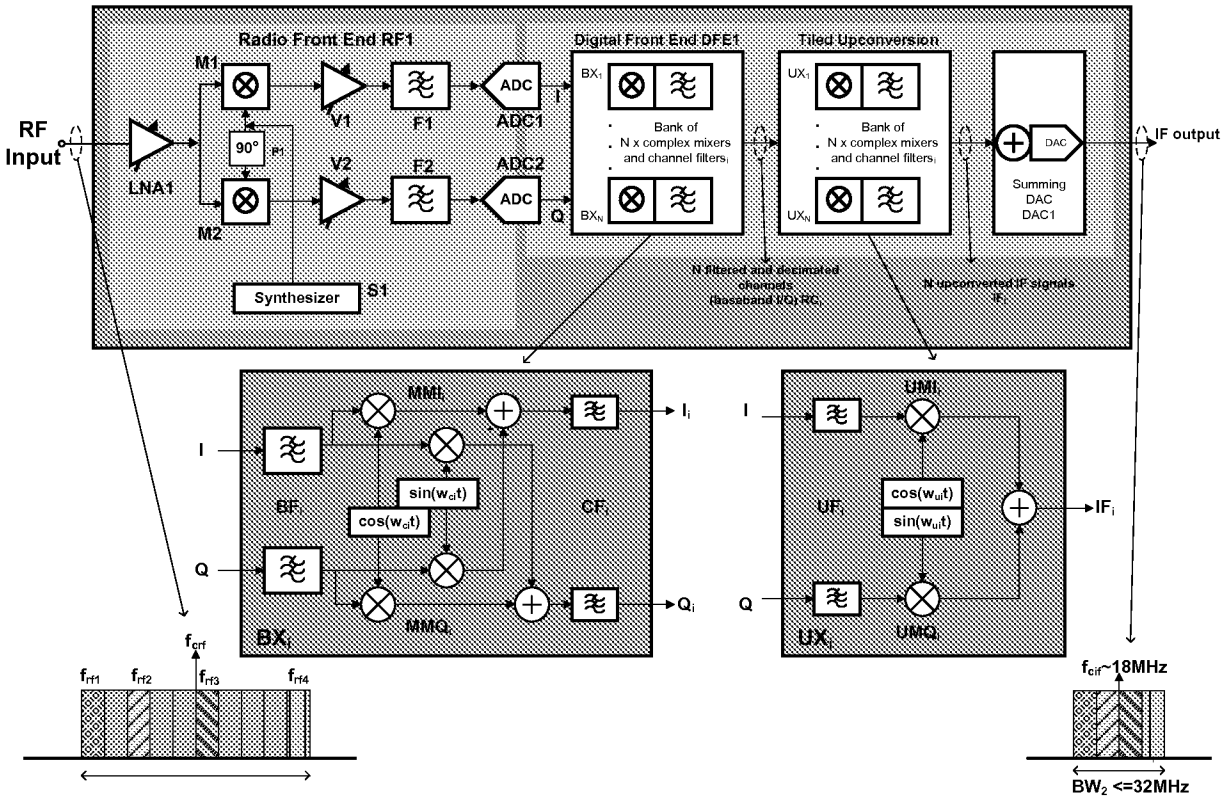

Figure 2. Illustration of the wideband personal radio recorder

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.

The invention focuses on how the swath of channels is preprocessed before being sent to the demodulator. The complex I/Q digital signal from the ADC pair feeds a bank of N complex mixers and filters BX_i which frequency-shift the N desired TV channels to baseband where they are each individually filtered, producing N filtered and decimated radio channels RC_i. These N channels can be sent to the demodulator in two ways:

1. The N channels can be sent together as a digital stream directly to the demodulator in digital form by serial or parallel data link using commonly-available methods. This

approach is advantageous compared with existing tuner architectures in that it eliminates expensive data conversion, filtering and channel selection on the demodulator side. Another significant advantage is that this architecture removes undesired channels from the signal path as soon as possible, relieving signal path dynamic range requirements in the demodulator.

2. Alternatively, the N channels can be upconverted by a bank of filters and mixers UX_i to IF signals at IF_i at frequencies f_{ui} which, when combined and converted to the analog domain by the summing DAC DAC1, align the IF signals as one contiguous set of channels in the spectrum centered at f_{if}, as illustrated in Figure 1. Because the bandwidth BW2 is substantially less than BW1, f_{if} can be proportionally lower, typically18MHz to accommodate a spectrum BW2 of up to 36MHz. This approach is advantageous because
    a. It allows the demodulator to run its data converter at a lower speed with fewer bits of resolution because the desired channels have been consolidated and the undesired ones eliminated, making the contiguous IF spectrum compact.
    b. It is fully compatible with existing demodulators which require an analog IF signal.
    c. As with method 1, this architecture removes undesired channels from the signal path as soon as possible, relieving signal path dynamic range requirements in the demodulator's ADC and within the demodulator itself.

2.1 ALTERNATIVE EMBODIMENT

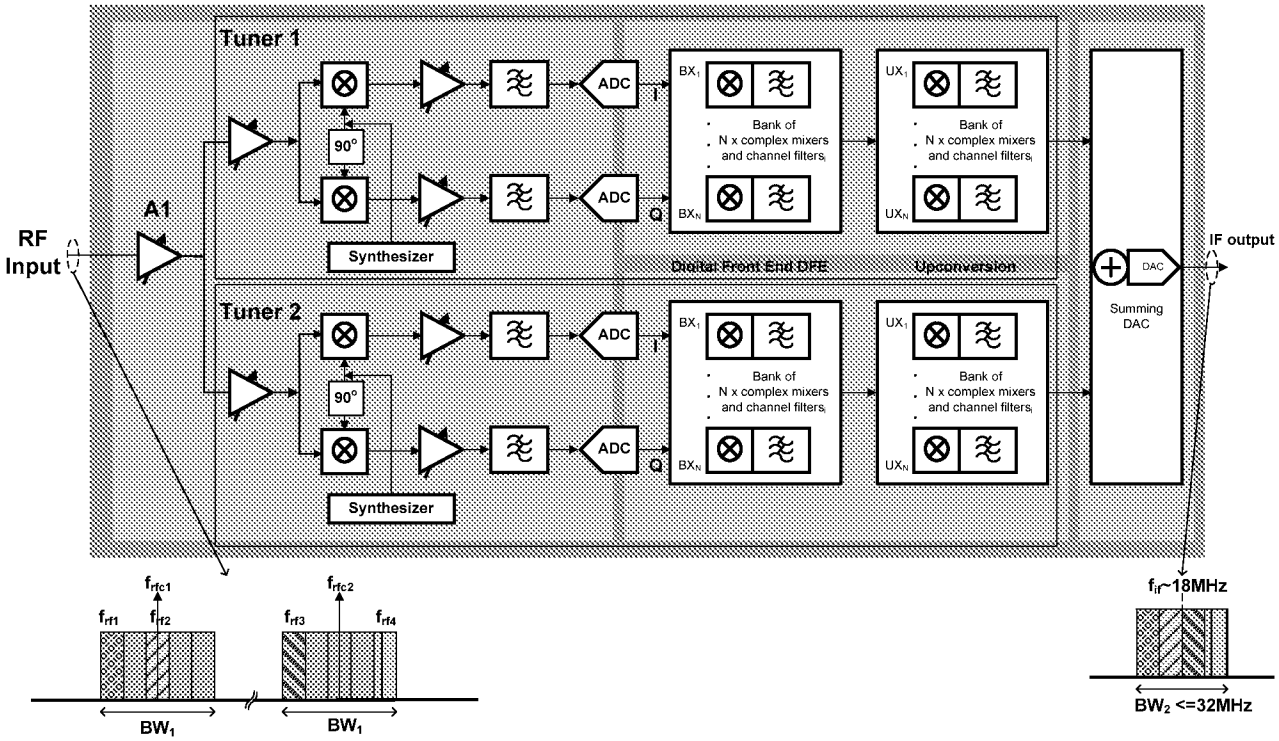

Figure 3. Embodiment of the invention applied to two tuner front ends.

The invention can be applied to any number of RF/digital front ends, as is shown in Figure 3 above. In this embodiment, Tuners 1 and 2 each receive portions of the RF spectrum centered at f_{rfc1} and f_{rfc2} respectively.
As before, the outputs from the two tuners are tiled to produce a contiguous set of IF frequencies centered at f_{if}.

Application Data Sheet

Application Information

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Subject Matter::	Utility
Suggested classification::	
Suggested Group Art Unit::	
CD-ROM or CD-R??::	
Number of CD disks::	
Number of copies of CDs::	
Sequence Submission::	
Computer Readable Form (CRF)?::	
Number of copies of CRF::	
Title::	WIDEBAND TUNER ARCHITECTURE
Attorney Docket Number::	022287-002700US
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Request for Non-Publication::	No
Suggested Drawing Figure::	
Total Drawing Sheets::	
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Latin name::	
Variety denomination name::	
Petition included?::	No
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Licensed US Govt. Agency::	
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Secrecy Order in Parent Appl.::	No

Applicant Information

Applicant Authority Type::	Inventor
Primary Citizenship Country::	US
Status::	Full Capacity
Given Name::	Madhukar
Middle Name::	
Family Name::	Reddy
Name Suffix::	
City of Residence::	Carlsbad
State or Province of Residence::	CA
Country of Residence::	US
Street of Mailing Address::	2011 Palomar Airport Road, Suite 305
City of Mailing Address::	Carlsbad
State or Province of mailing address::	CA
Country of mailing address::	US
Postal or Zip Code of mailing address::	92011

Applicant Authority Type::	Inventor
Primary Citizenship Country::	US
Status::	Full Capacity
Given Name::	Curtis
Middle Name::	
Family Name::	Ling
Name Suffix::	
City of Residence::	Carlsbad
State or Province of Residence::	CA
Country of Residence::	US
Street of Mailing Address::	3667 Adams Street
City of Mailing Address::	Carlsbad
State or Province of mailing address::	CA
Country of mailing address::	US

Postal or Zip Code of mailing address:: 92008

Correspondence Information

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Representative Information

Representative Customer Number:: 20350

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Country:: Application number:: Filing Date::

Assignee Information

Assignee Name::

Street of mailing address::

City of mailing address::

State or Province of mailing address::

Country of mailing address::

Postal or Zip Code of mailing address::

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	WIDEBAND TUNER ARCHITECTURE
First Named Inventor/Applicant Name:	Madhukar Reddy
Filer:	Ardeshir Tabibi/Eleanor Taylor
Attorney Docket Number:	022287-002700US

Filed as Small Entity

Provisional Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Provisional Application filing fee	2005	1	110	110
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

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Miscellaneous:				
			Total in USD ($)	**110**

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First Named Inventor/Applicant Name:	Madhukar Reddy
Customer Number:	20350
Filer:	Ardeshir Tabibi/Eleanor Taylor
Filer Authorized By:	Ardeshir Tabibi
Attorney Docket Number:	022287-002700US
Receipt Date:	17-APR-2009
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Application Type:	Provisional

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RAM confirmation Number	5536
Deposit Account	201430
Authorized User	

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1	Specification	Application.pdf	150752 cdc9854c0493008d8c6df098526847d713bb76df	no	6
Warnings:					
Information:					
2	Application Data Sheet	Application_Data_Sheet.pdf	52978 2a0904c8b981cb00495edf65734df7650b82c811	no	3
Warnings:					
Information:					
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3	Fee Worksheet (PTO-06)	fee-info.pdf	29501 1600dc4eb535f60033167ec7cc397f1f89c803d3	no	2
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61/170,526	04/17/2009		110	022287-002700US		

CONFIRMATION NO. 4157

FILING RECEIPT

OC000000035690382

20350
TOWNSEND AND TOWNSEND AND CREW, LLP
TWO EMBARCADERO CENTER
EIGHTH FLOOR
SAN FRANCISCO, CA 94111-3834

Date Mailed: 05/04/2009

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Applicant(s)

Madhukar Reddy, Carlsbad, CA;
Curtis Ling, Carlsbad, CA;

Power of Attorney: None

If Required, Foreign Filing License Granted: 04/27/2009

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 61/170,526**

Projected Publication Date: None, application is not eligible for pre-grant publication

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Early Publication Request: No
**** SMALL ENTITY ****
Title

WIDEBAND TUNER ARCHITECTURE

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