IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the *Inter Partes* Review of U.S. Patent No. 7,639,982

Trial No.:	Not Yet Assigned
Issued:	December 29, 2009
Filed:	December 19, 2003
Inventors:	Philip M. Wala
Assignee:	COMMSCOPE TECHNOLOGIES LLC
Title:	POINT-TO-MULTIPOINT DIGITAL RADIO FREQUENCY TRANSPORT

MAIL STOP PATENT BOARD
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PETITION FOR *INTER PARTES* REVIEW UNDER 37 C.F.R. § 42.100

On behalf of SOLiD, Inc. ("SOLiD" or "Petitioner") and in accordance with 35 U.S.C. § 311 and 37 C.F.R. § 42.100, *inter partes* review ("IPR") is respectfully requested for claims 1-10, 25-32, 34, 35, 37-51, and 75-81 of U.S. Patent No. 7,639,982 ("the '982 patent") (Ex. 1001).

The undersigned representative of Petitioner authorizes the Office to charge the Petition and Post-Institution Fees, and any additional fees, to Deposit Account 503013, ref: 428880-605001.

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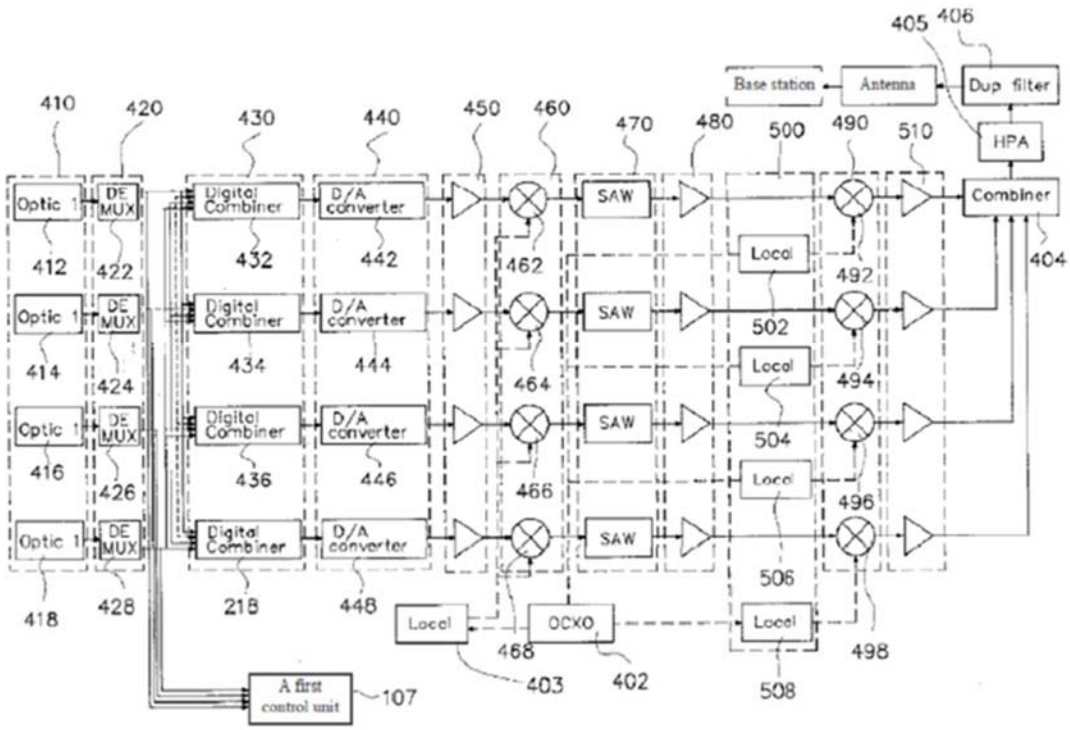
I. Introduction

U.S. Patent No. 7,639,982 (the ’982 patent) describes a digital antenna system that enables extension of radio frequency (RF) analog signals from base stations to areas (*e.g.*, inside of buildings) where access to such signals is inhibited. The ’982 patent systems include a digital host unit that communicates with a base station, and a plurality of remote units distributed within the hard to reach area. On the forward path, the ’982 patent digitizes analog signals received from the base station and transmits those digital signals to the remote units. The remote units then convert the digital signals back to analog and forward them to nearby wireless devices via their antennas. On the reverse path, the remote units sample and digitize analog RF signals received at the antennas and forward the digital data to the host unit. The host unit sums digital sample data received from multiple remote units and uses the summed data values to generate analog signals that are forwarded to the base station.

The ’982 patent was allowed in part based on claim features describing the digital host unit performing the digital summing operation on digitized radio frequency signals received at the host unit. *See*, Ex. 1001, claim 1. While the Examiner found the claims of the ’982 patent to be patentable, the Examiner did not have the benefit of the Oh reference (Ex. 1007) cited herein. The Examiner’s failure to find the Oh reference is understandable because Oh is a publication of a Korean patent application filed in April 1999 that was published in Korean in August 1999.

FIG. 5



Had the Examiner had access to the Oh reference during prosecution, the ’982 patent would not have issued.

II. Grounds For Standing Pursuant To 37 C.F.R. § 42.104(a)

Petitioner certifies the ’982 patent is available for IPR and Petitioner is not barred or estopped from requesting IPR challenging the patent claims on the grounds herein.

III. Background Information For The ’982 Patent

A. Overview Of The ’982 Patent

The ’982 patent is directed to a digital distributed antenna system illustrated in Fig. 1 having a host unit and multiple distributed remote antenna units.

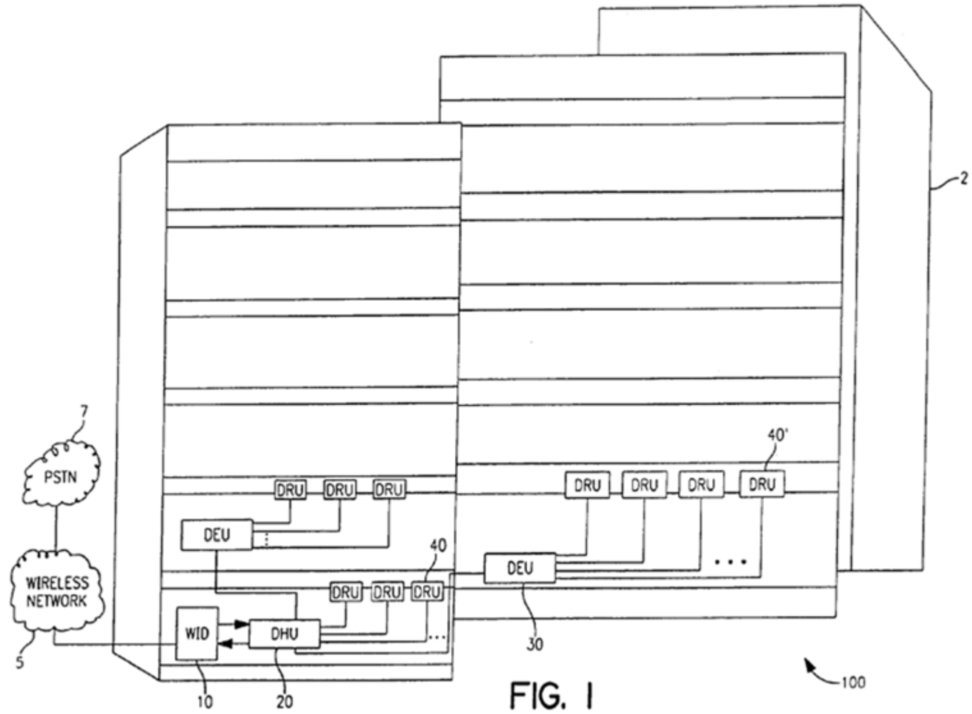
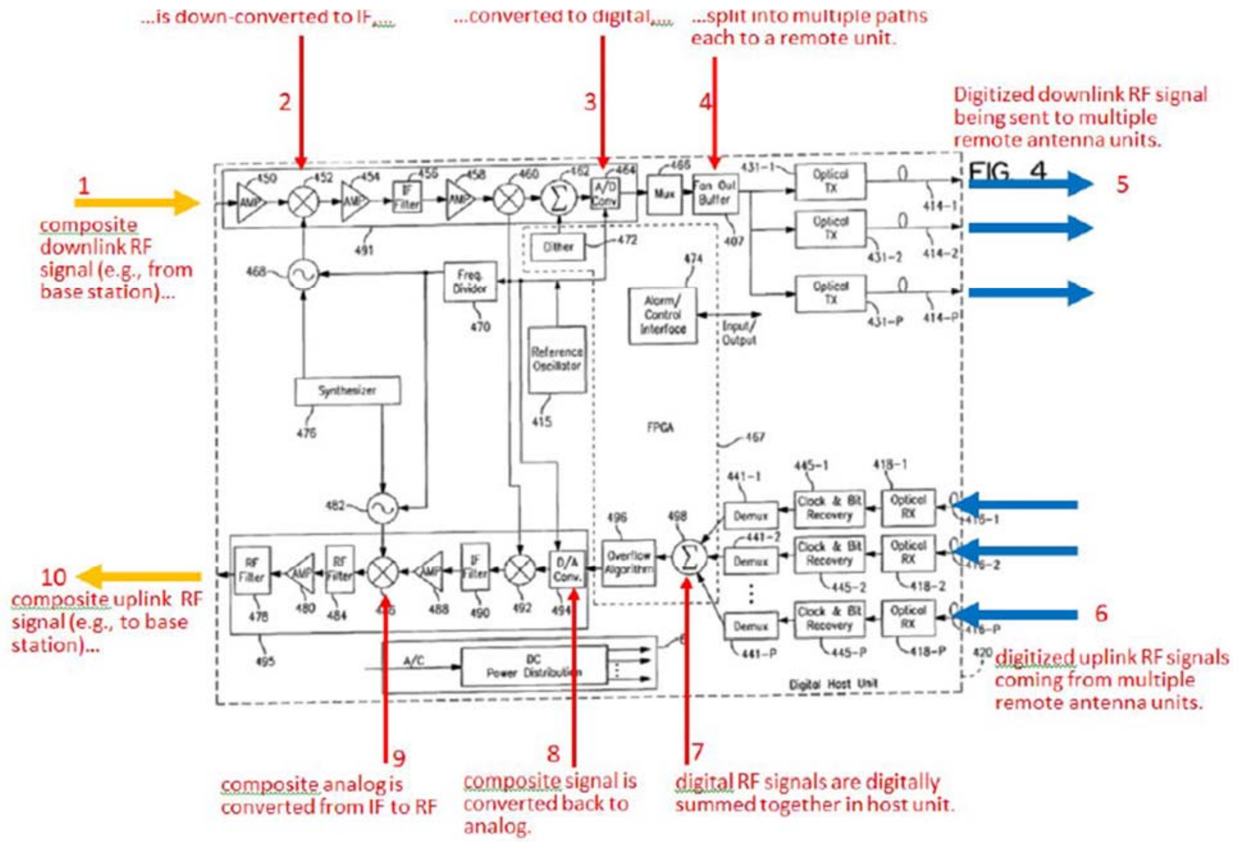


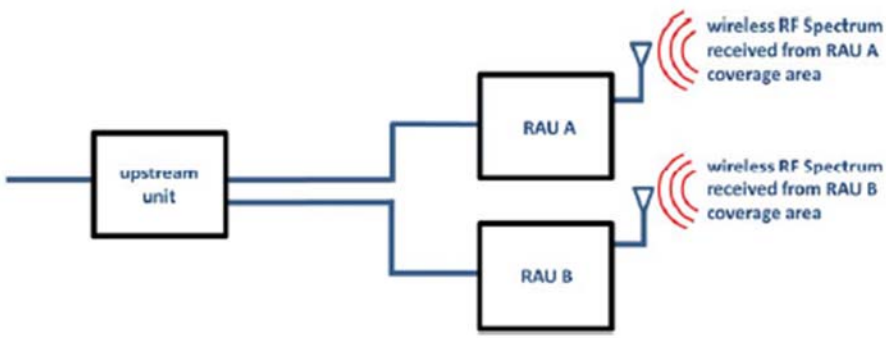
FIG. 1

Annotated Fig. 4 of the ’982 patent below illustrates a host unit that provides digitization of an RF signal received from a base station (top left) for distribution to multiple digital remote units (top right). Annotated Fig. 4 illustrates creation of an uplink RF signal for transmission to the base station (bottom left) based on digital samples received from multiple digital remote units (bottom right).

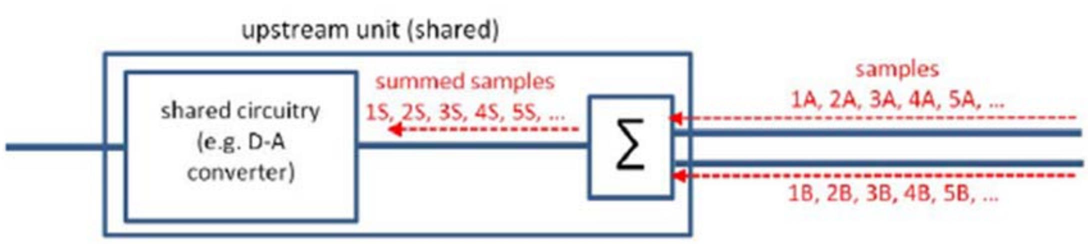


In the downlink direction, the host unit down-converts a composite downlink RF signal, takes a sequence of digitized samples, and delivers a sequence of digitized samples over a fiber optic cable to each of several remote units. Ex. 1001, 7:3-17. At each digital remote unit, the arriving stream of digital samples are converted back into the analog signal from which they are derived and then delivered to an antenna for transmission. *Id*., 9:5-20.

In the uplink direction, each remote unit receives the wireless RF spectrum from its coverage area and converts this to a sequence of digital samples that are sent over a fiber optic cable to the host unit.



Ex. 1001, 9:34-38 (drawing from Ex. 1008, ¶173, Patent Owner's background description of this patent family showing remote antenna units (RAU) relaying signals from wireless devices to an upstream unit, *e.g.*, a host unit). The upstream unit receives the sequence of samples from the respective remote units and digitally sums the corresponding digital samples from the respective remote units by summing corresponding digital values of the recorded samples.



Ex. 1001, 7:53-8:7; Ex. 1008, ¶177. The summed digital samples are then converted into an analog signal and converted to an RF signal for delivery to the base station. *Id.*, Ex. 1005, ¶¶59-63.

B. Overview Of The Prosecution History

The '982 patent issued after eight Office Actions and corresponding responses. The Applicant amended certain aspects of the claims (*e.g.*, claim 1) to recite that the digital host unit digitally sums the digitized radio frequency signals received at the digital host unit. Ex. 1006, 465. Applicant further differentiated the claims from the Examiner-cited prior art based on the resolution of signals involved in digitally summing operations (*e.g.*, claim 37, Ex. 1006, 69-70), and the location of summing operations being at the host unit and not remote units (*e.g.*, claim 1, Ex. 1006, 72-73).

The Oh reference cited herein clearly discloses these features, where Oh's digital combiner unit 430 resides in master unit 20 and includes digital combiners 432, 434, 436, 438 that perform digital combining by "creating 14-bit intermediate frequency signals by combining four 12-bit intermediate frequency signals in the same frequency band." Ex. 1007, 5:16-17. Oh was not considered by the Examiner during prosecution of the '982 patent. Ex. 1005, ¶¶58, 64.

C. Level Of Skill In The Art

A person of ordinary skill in the art ("POSITA") as of July 2000 (the earliest patent filing date to which the '982 patent could claim priority) would have possessed at least a bachelor's degree in electrical engineering with at least two years of industry experience with data communications system (or equivalent degree or experience). Ex. 1005, ¶¶3-19, 28-30. A person could also have qualified as a POSITA with some combination of (1) more formal education (such as a master's of science degree) and less technical experience, or (2) less formal education and more technical or professional experience. *Id.*

IV. Identification Of Challenge Pursuant To 37 C.F.R. § 42.104(b)

A. 37 C.F.R. § 42.104(b)(1): Claims For Which IPR Is Requested

IPR is requested for claims 1-10, 25-32, 34, 35, 37-51, and 75-81 of the '982 patent.

B. 37 C.F.R. § 42.104(b)(2): The Prior Art And Specific Grounds On Which The Challenge To The Claims Is Based

IPR is requested in view of the following references:

- Korean Laid-Open Disclosure No. KR1999-0064537 to Oh ("Oh") (Ex. 1007). Oh is prior art to the '982 patent at least under 35 U.S.C. § 102(a).
- "A New Microcell Architecture Using Digital Optical Transport," Wala ("Wala"), IEEE, 1993 (Ex. 1009). Wala is prior art to the '982 patent under at least 35 U.S.C. §§ 102 (a) and (b).
- U.S. Patent No. 5,969,837 to Farber ("Farber"). Farber is prior art to the '982 patent under at least §§ 102(a), (b), and (e).

The specific statutory grounds on which the challenge to the claims is based and prior art relied upon for each ground are as follows:

Ground 1a: Claims 1-10, 25-32, 34, 35, 37-51, and 81 are unpatentable under 35 U.S.C. § 103 over Oh; and

Ground 1b: Claims 75-80 are unpatentable under 35 U.S.C. § 103 over Oh in view of Wala. Ex. 1005, ¶¶23-27.

C. 37 C.F.R. § 42.104(b)(3): Claim Construction

The Board gives claims their ordinary and customary meaning, or "the meaning that the term would have to a [POSITA] at the time of the invention." *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312-13 (Fed. Cir. 2005) (en banc). Other than the "means-plus-function" claim terms governed by 35 U.S.C. § 112 ¶6 in claim 81, Petitioner proposes no claim terms for construction at this time.

Petitioner identifies functions and corresponding structures for the various means-plus-function terms introduced in claim 81. Petitioner further identifies where those structures are described in the specification in accordance with 37 C.F.R. 42.104(b)(3). Petitioner does not waive, and expressly reserves, its claim scope arguments, constructions, and evidence it may raise in other proceedings. Ex. 1005, ¶¶22, 68-69.

Claim 81 Limitation	Function	Structure
means for communicatively coupling…	communicatively coupling the first unit to a plurality of second units	Fig. 4: Optical Transmission Lines 414, 416
means for digitizing…	digitizing an original downstream analog radio frequency signal in order to produce downstream digital RF samples	Fig. 4: Amplifier 450, Mixer 452, Amplifier/Filter 454, 456, 458, Mixer 460, A/D

		Converter 464
means for communicating…	communicating at least a portion of the downstream digital RF samples to the plurality of second units	Fig. 4: Optical Transmitters 431-1 – 431-P
means for receiving…	receiving from the plurality of second units respective upstream digital RF samples	Fig. 4: Optical Receivers 418
means for digitally summing…	digitally summing respective upstream digital RF samples received from the plurality of second units in order to produce each of a stream of summed upstream digital RF samples	Fig. 4: Summer 498
means for converting…	converting the stream of summed upstream digital RF samples to a replicated upstream analog radio frequency	Fig. 4: D/A Converter 494, Mixer 492, Amplifier/Filter 488, 490, Mixer 486

D. 37 C.F.R. § 42.104(b)(4): How The Construed Claims Are Unpatentable

An explanation of how the challenged claims are unpatentable, including where each claim feature is found in the prior art and the motivation to combine the prior art, is set forth below in Section V.

E. 37 C.F.R. § 42.104(b)(5): Supporting Evidence

An Appendix of Exhibits supporting this petition is attached. Exhibit 1005 is a supporting Declaration of Dr. R. Jacob Baker.

V. There Is A Reasonable Likelihood The Challenged Claims Of The '982 Patent Are Unpatentable

A. Brief Overview Of The Prior Art

1. Overview Of Oh

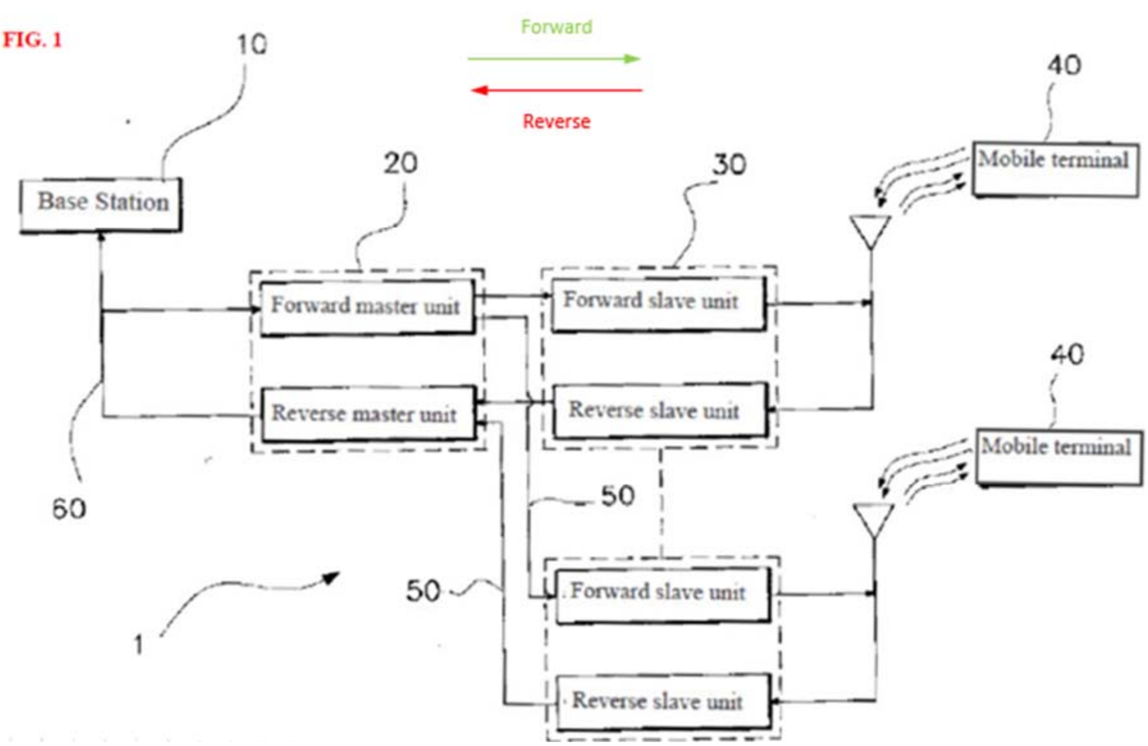
Oh is a publication of a Korean patent application filed by Yong Hoon Oh on April 3, 1999. Oh was published on August 5, 1999.

Oh discloses an optic repeater system that is installed to facilitate communications to and from "radio wave shadow area" where base station signals are unable to reach. Ex. 1007, 2:4-7. When a "base station is far away" or when the mobile terminal is "in the radio wave shadow area, the base station cannot perform streamlined transmission/reception to/from the mobile terminals." *Id.*, 2:11-13.

Optic repeater systems were used prior to Oh in an attempt to provide wireless access to mobile terminals in the radio wave shadow area. *Id.*, 2:16-19. In those historic systems, transmissions between the primary unit and the remote units across an optic line were analog. *Id.*, 2:20-22. But because "the RF signals transmitted/received to/from said first optic repeater and a second optic repeater [were] analog signals, the strength of the signals is greatly decreased during transmission through the optical line." *Id.*, 2:28-30. This analog signal attenuation required implementation of signal amplifiers in prior systems, which exacerbated signal-to-noise ratio issues. *Id.*, 2:30-33.

To address the analog signal attenuation issue, Oh "provide[s] a digital optical repeater that can maximize the efficiency of signal transmission in such a way that the optic repeater converts the intermediate frequency signals, analog signals, to the digital signals and transmits/receives them through the optical line." *Id.*, 2:36-39. An Oh optic repeater system includes a first optic repeater (master unit 20) that is in communication with the base station 10 and second optic repeaters (slave units 30) that are distributed within the radio wave shadow area. *Id.*, Abstract, 2:19-20.

FIG. 1



On the forward path (left-to-right in Fig. 1), RF signals are received by the forward portion of master unit 20 from the base station 10 and are processed by the forward master unit 100. *Id.*, 2:72-73. The forward master unit 100 "converts RF signals, analog signals, transmitted from the base station 10 to the intermediate frequency signals; converts them to digital signals; and transmits them to the slave unit 30 through the optic line 50." *Id.*, 3:5-6. The forward portion of the slave units 30 (*e.g.*, forward slave unit 200) "converts digital signals to the intermediate frequency signals, analog signals; converts the intermediate frequency signals to RF signals; and transmits them to the mobile terminals 40. *Id.*, 3:1-4.

On the reverse path (right-to-left in Fig. 1), the reverse portion of slave unit 30 (*e.g.*, reverse slave unit 300) converts analog RF signals received from the mobile terminals 40 to digital signals and transmits them to master unit 20 through the optic line 50. *Id.*, 4:23-25. The reverse portion of master unit 20 (*e.g.*, reverse master unit 400) "converts the digital signals transmitted from the slave unit 30 through the optic line 50 to the intermediate frequency signals, analog signals, converts them to the RF signals, and transmits them to the base station 10." *Id.*, 4:62-64.

FIG. 2

Labels for 182, 184, 186, 188 fixed here. See Oh, 3:40 ("four A/D converters 182, 184, 186, and 188")

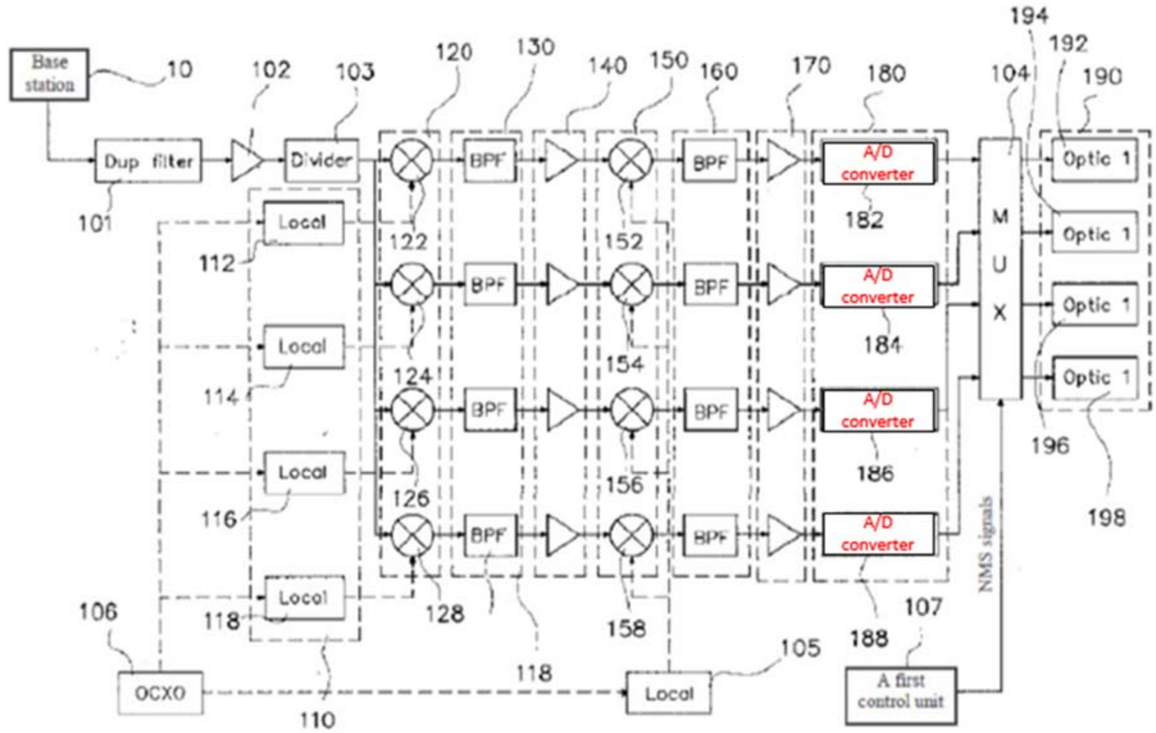


Fig. 2 provides example detail of the forward portion of Oh's master unit 20. The forward master unit receives RF signals from the base station 10 through a bi-directional filter 101. A divider 103 divides the RF signals into its component frequency bands (*i.e.*, the component frequency bands that make up the RF signal received from the base station 10), where each of those component band signals is processed in parallel through first mixer unit 120, band pass filter (BPF) 130, amplifier 140, second mixer unit 150, second BPF 160, and second amplifier 170 collectively to transition the signals from their band frequencies to baseband frequency close to DC. *Id.*, 3:6-14. Analog to Digital (A/D) converters 182, 184, 186, 188 sample the baseband signals to convert them to digital representations of the analog component frequency band signals. *Id.*, 3:14-16. Multiplexer 104 multiplexes the four 12-bit digital sample values with 4-bit network management system (NMS) control data from control unit 107 and applies that 52-bit (*i.e.*, the 4-12-bit words plus the 4-bit NMS control information) serial data stream to each of a plurality of optic converters 192, 194, 196, 198 for transmission across optic lines 50 to destination slave units. *Id.*, 3:38-44.

FIG. 3

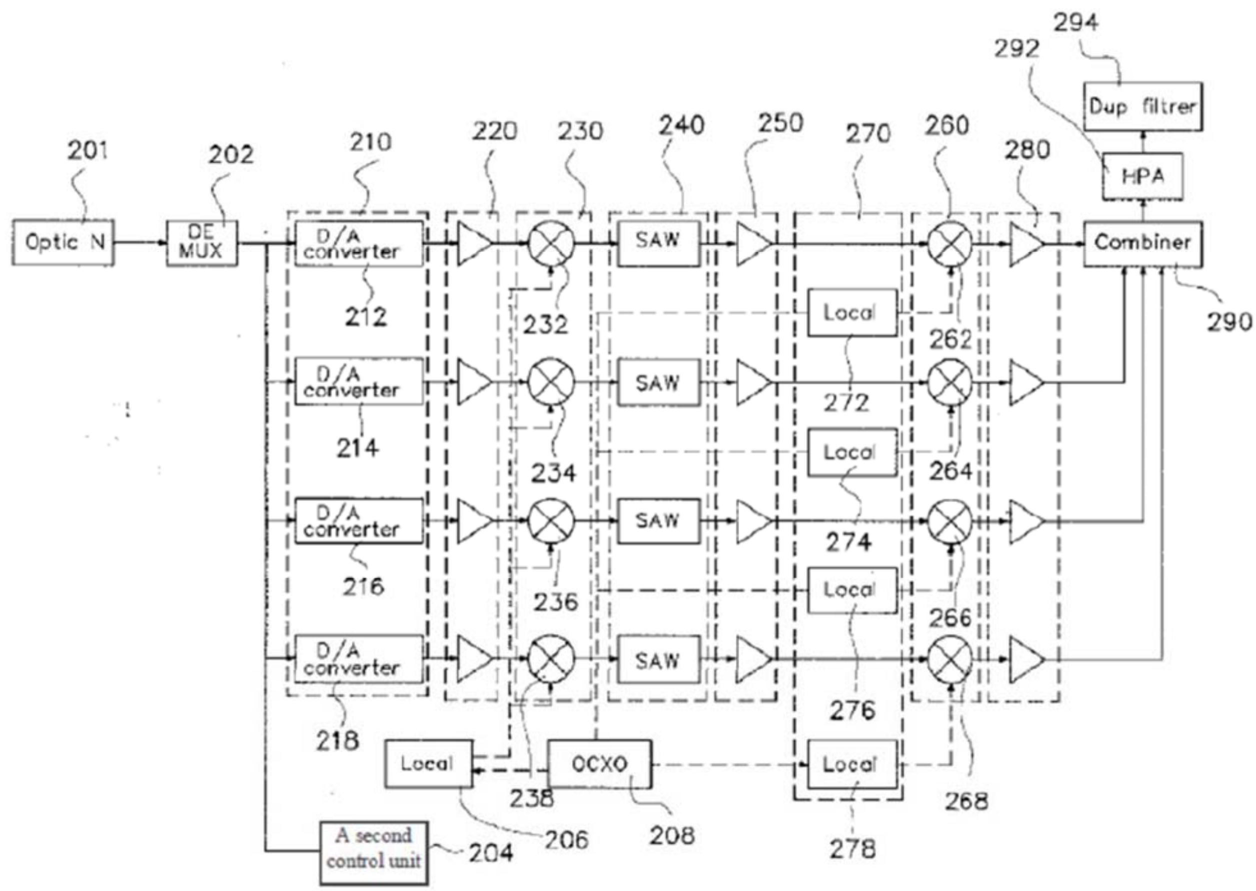


Fig. 3 provides example detail of the forward portion of one of Oh's slave units 30. The 52-bit digital signal transmitted on one of the optic lines 50 is received at a second optic converter unit 201. "[C]ombiner 290 [] combines the RF signals of four different frequency bands [*i.e.*, analog combining (Ex. 1005, ¶58)]… and transmits them to the mobile terminals 40 through a second power amplifier 292 and a second bi-directional filter 294." Ex. 1007, 3:59-61.

FIG. 4

Labels for 382, 384, 386, 388 fixed here. See Oh, 4:53-54 ("four A/D converters 382, 384, 386, 388")

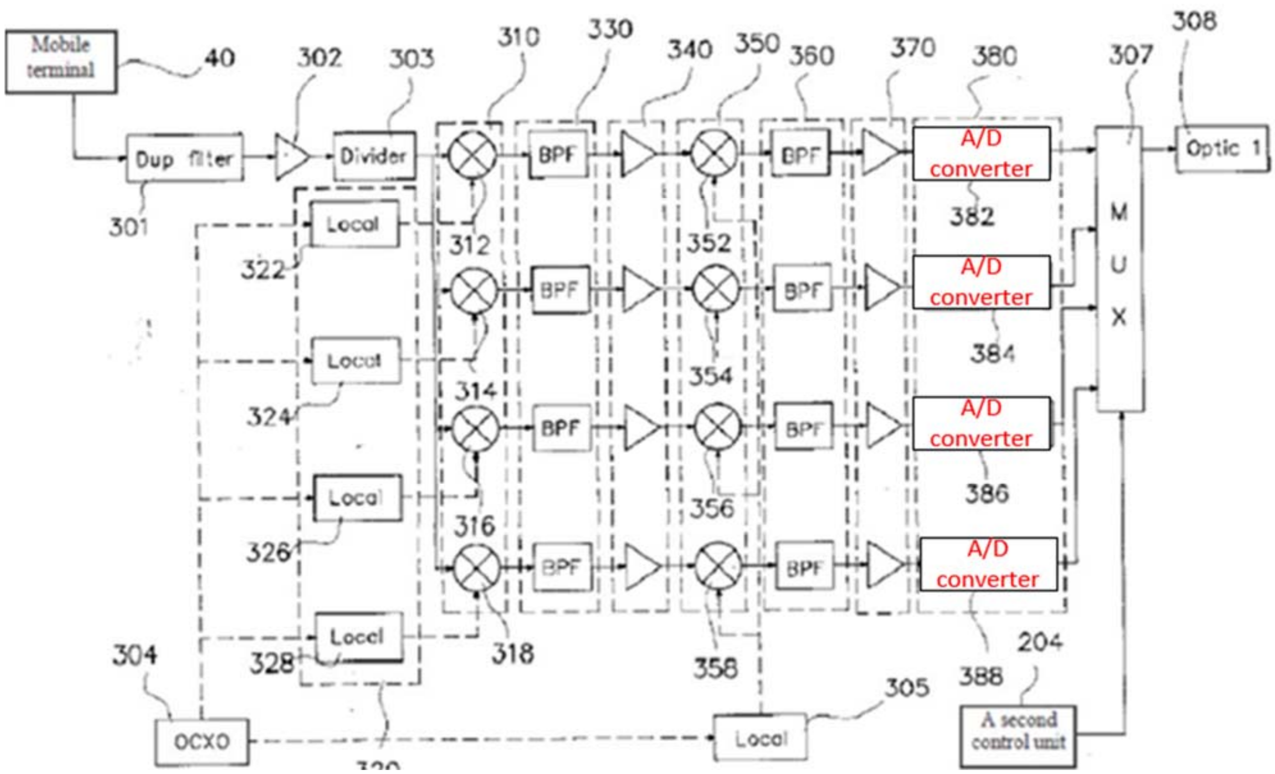


Fig. 4 illustrates example details of the reverse path at a slave unit 30 (*e.g.*, reverse slave unit 300). "RF signals transmitted from the mobile terminals 40 of the reverse slave unit 300 of the slave unit 30 through the antenna are converted to the intermediate frequency signals close to DC…, mixed with the NMS signals transmitted from a second control unit 204, and transmitted to the reverse master unit 400 through the optic line." *Id.*, 4:16-18.

FIG. 5

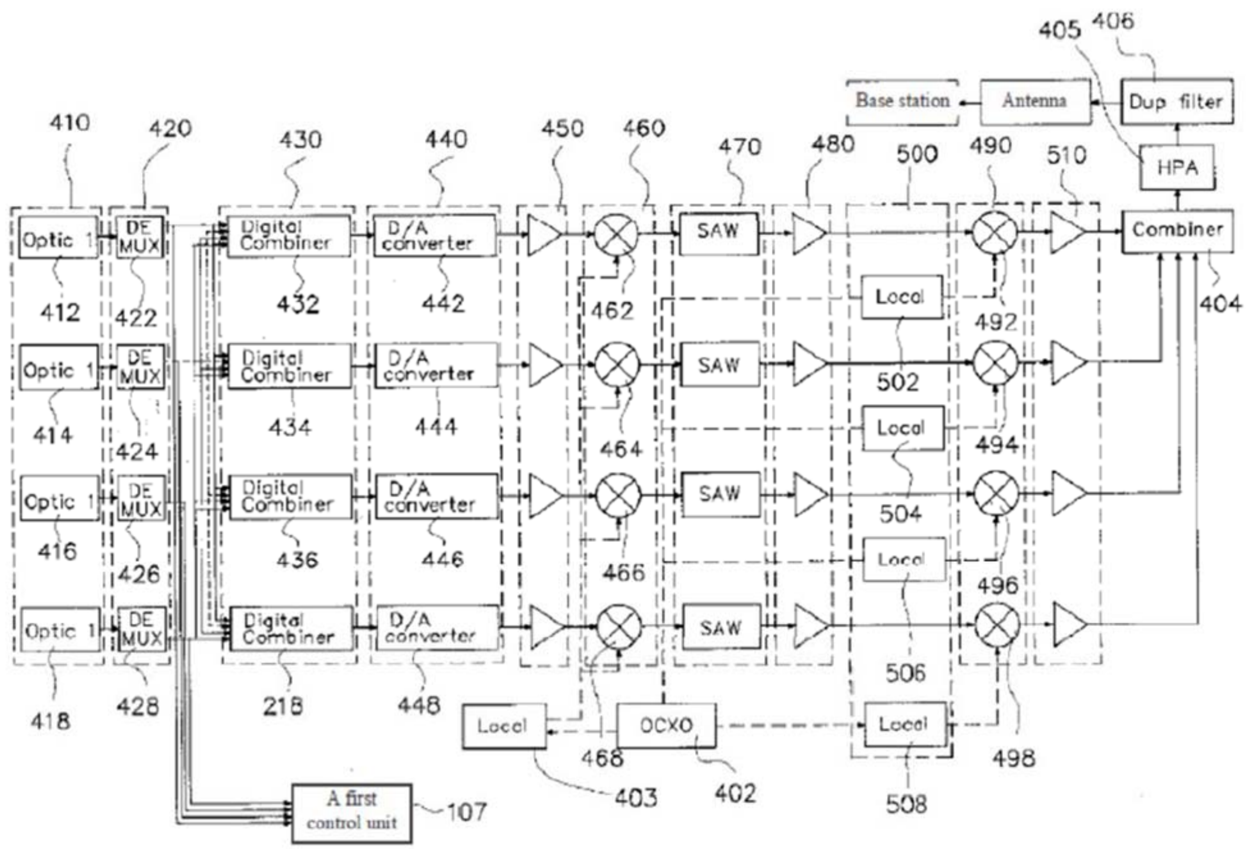


Fig. 5 illustrates example detail of the reverse path at the master unit 20 (*e.g.*, reverse master unit 400), which receives four streams of digital data from four slave units over optic lines (*i.e.*, digital data from a first slave unit at 412, a second slave unit at 414, a third at 416, and a fourth at 418). Each demultiplexer 422-428 is associated with a respective one of the remote slave units to route digital sample data to its respective frequency band path in the reverse unit. Each demultiplexer 422-428 receives digital sample data and control data from one slave unit 30 and separates that digital sample data according to frequency band. *Id.*, 5:4-10. In the example where the reverse master unit of Fig. 5 is connected to four slave units 30, the 52-bit data from the slave unit is demultiplexed at a first demultiplexer, with one 12-bit data sample being sent to each of four digital combiners and 4-bit control data to control unit 107. *Id.*, 5:11-12. Thus, demultiplexer 422 sends a 12-bit sample associated with a first frequency band to first digital combiner 432, a 12-bit sample for second band to combiner 434, a 12-bit sample for third band to combiner 436, and a 12-bit sample for fourth band to combiner 438. Demultiplexers 424, 426, 428 similarly send 12-bit samples to each of the digital combiners 432, 434, 436, 438. *Id.*, 5:11-15.

Each digital combiner 432, 434, 436, 438 receives four digital samples associated with its band and "aggregates the same digital signals transmitted from each demultiplexer." Specifically, each digital combiner performs digital combining "by combining four 12-bit intermediate frequency signals in the same frequency band" to "creat[e] 14-bit intermediate frequency signals." *Id.*, 4:69; 5:16-17; Ex. 1005, ¶58. Those 14-bit digital signals are then applied to respective D/A converters 442, 444, 446, 448 to provide intermediate frequency signals. Ex. 1007, 5:18. The intermediate frequency signals are shifted to their respective band frequencies by being amplified at 450, mixed with a step up frequency at 460, filtered at 470, amplified again at 480, mixed with a respective frequency at 490 to recreate the radio frequency signals, and amplified again at 510. *Id.*, 4:73-5:2. "[C]ombiner 404 aggregates the RF signals in different frequency bands [i.e., performs analog combining (Ex. 1005, ¶58)]… amplifies the strengths and level in a first power amplification unit 405, and transmits them to the base station 10 through a fourth bi-directional filter 406" such as via an antenna as depicted in Fig. 5 or an RF cable. Ex. 1007, 5:27-29.

Oh shows multiple, different example ways of communicating with a base station. For example, a wired connection (*e.g.*, RF cable 60) is illustrated in FIG. 1 between the base station 10 and master unit 20. Oh also illustrates a wireless connection (*e.g.*, antenna in Fig. 5) between the first bi-directional filter 406 of the master unit 20 and the base station 10. A POSITA would understand that the most straightforward, inexpensive system would perform downstream and upstream communications with the base station using the same medium type (*e.g.*, RF cable or wireless). Oh's explicit disclosure of wired and wireless base station communication options evidences the obviousness of implementing upstream and downstream communications with the base station in a wired implementation or a wireless implementation.

Oh is analogous art to the '982 patent because it is in the same field of endeavor (RF data communications) and it is associated with the common problem of extending RF data communications into hard to reach areas. Ex. 1005, ¶¶70-85; Ex. 1007, 2:4-13.

2. Overview Of Wala

Like the '982 patent and Oh, Wala addresses expansion of RF signal coverage into hard to reach areas "including shadow areas, tunnels, and the interiors of high-rise office buildings." Ex. 1009, 585. Also like the '982 patent and Oh, Wala recognizes the limitations of forwarding of analog signals in such coverage extension systems including signal-to-noise ratio issues. Thus Wala proposes a digital radio frequency transport system similar to the '982 patent and Oh.

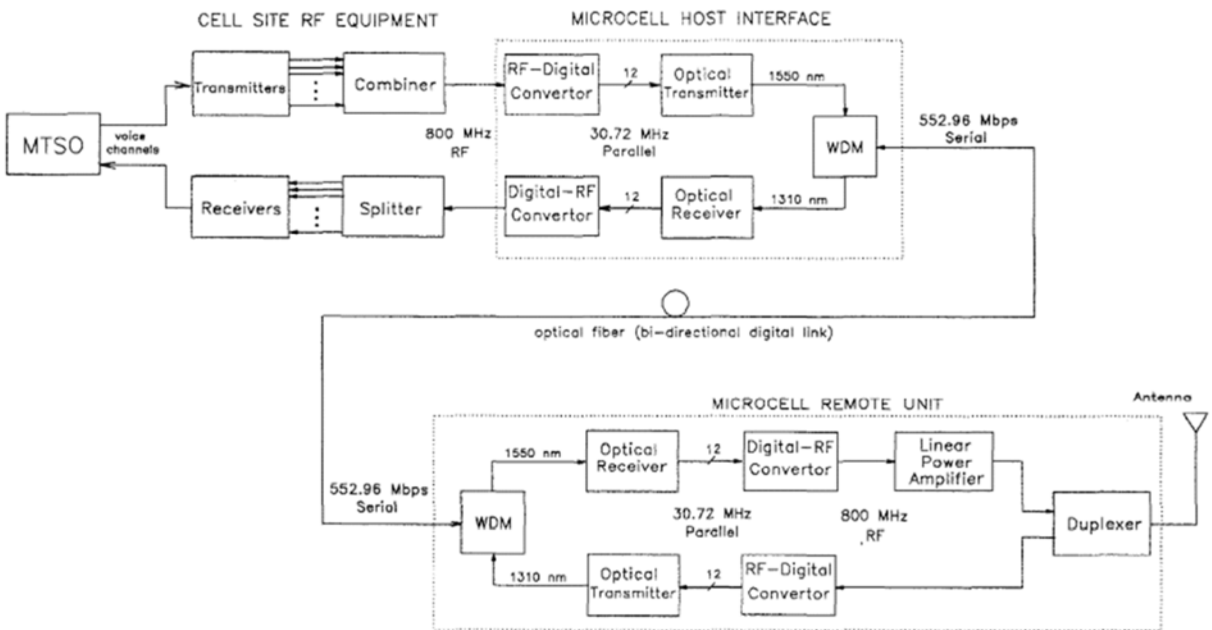
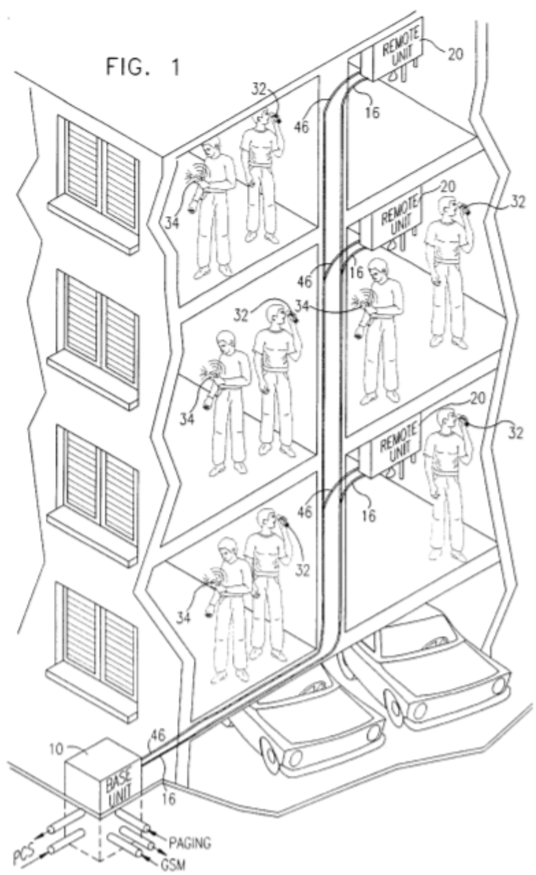


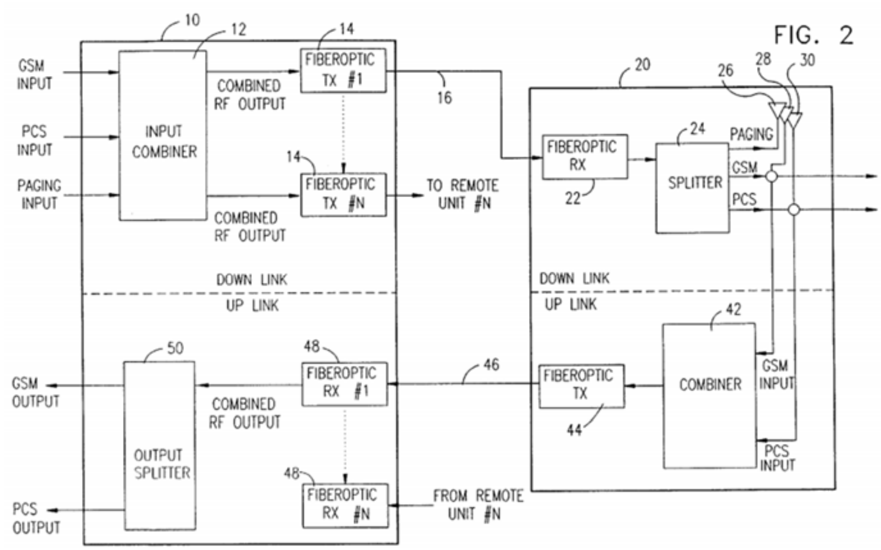
Fig.1. Digital RF transport microcell: system block diagram

Wala is analogous art to the '982 patent because it is in the same field of endeavor (RF data communications) by the '982 patent's inventor and it is associated with the common problem of extending RF data communications into hard to reach areas. Ex. 1005, ¶¶86-87; Ex. 1009, 585-586.

3. Overview of Farber

Farber describes a wireless communications station employing optical fibers. Ex. 1022, 1:4-6. Farber discloses the use of fiber in an antenna system for reaching difficult coverage areas such as buildings, as illustrated in Fig. 1, and other shadowed areas that is very similar to the digital system of Oh. *Id.*, 4:30-33. Farber states that the optical fibers "may be single or multi mode." *Id*., 2:59-60. With reference to Fig. 2, Farber describes that "[p]referably the fiberoptic transmitter employs a vertical cavity surface emitting laser or an edge emitting laser coupled to a single or multi-mode fiber." *Id*., 2:51-53; Ex. 1005, ¶88.





B. Ground 1a: Claims 1-10, 25-32, 34, 35, 37-51, and 81 Are Obvious Over Oh

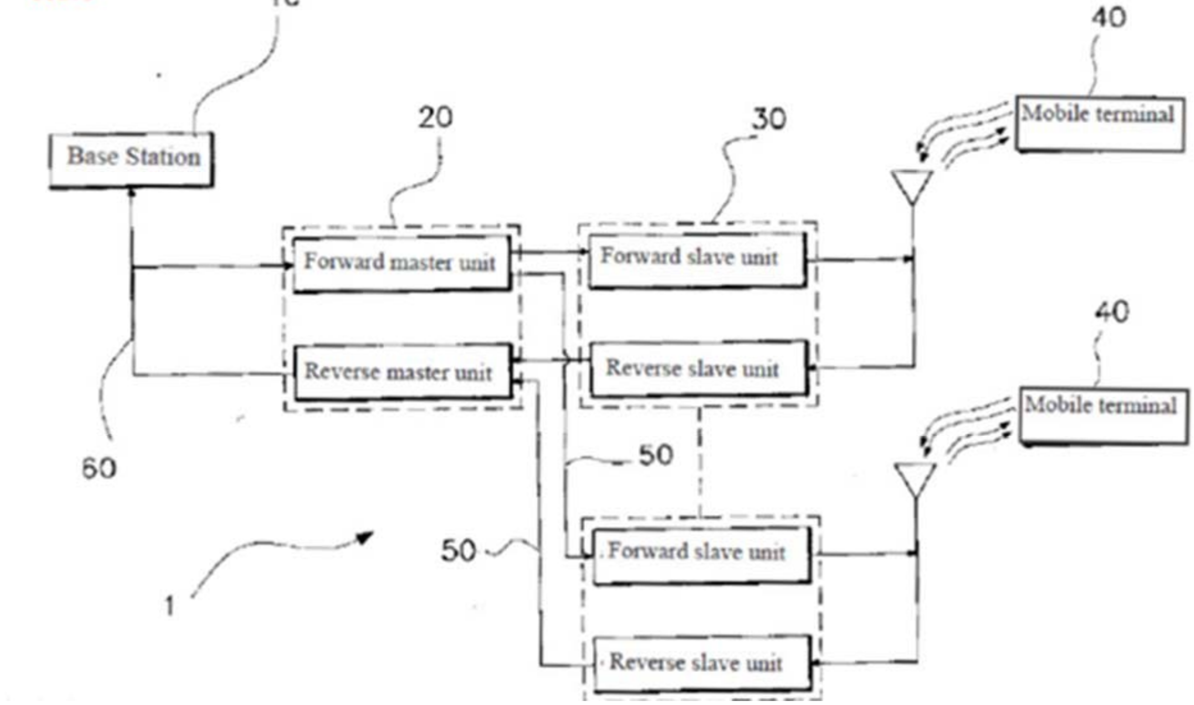
1. Independent Claim 1

(a) Preamble: "A digital radio frequency transport system, comprising:"

To the extent the preamble of claim 1 is limiting, it is rendered obvious by Oh.

As discussed above, Oh discloses a Digital Optic Repeater system that receives RF signals, from a base station 10 at a master unit 20 and from mobile terminals 40 at remote slave units 30. The optic repeater 1 is installed in a radio wave shadow area and converts received analog signals to intermediate frequency signals (*e.g.*, close to DC in the example at 3:11-14) and then to digital signals for mutual transmission and reception to one another across optic lines 50. Ex. 1007, Abstract, Fig. 1. At a destination unit, the digital signals transmitted across the optic lines 50 are converted to analog signals, and upconverted to RF signals for transmission to their destination (*e.g.*, base station 10 or mobile terminals 40). *Id.*

FIG. 1



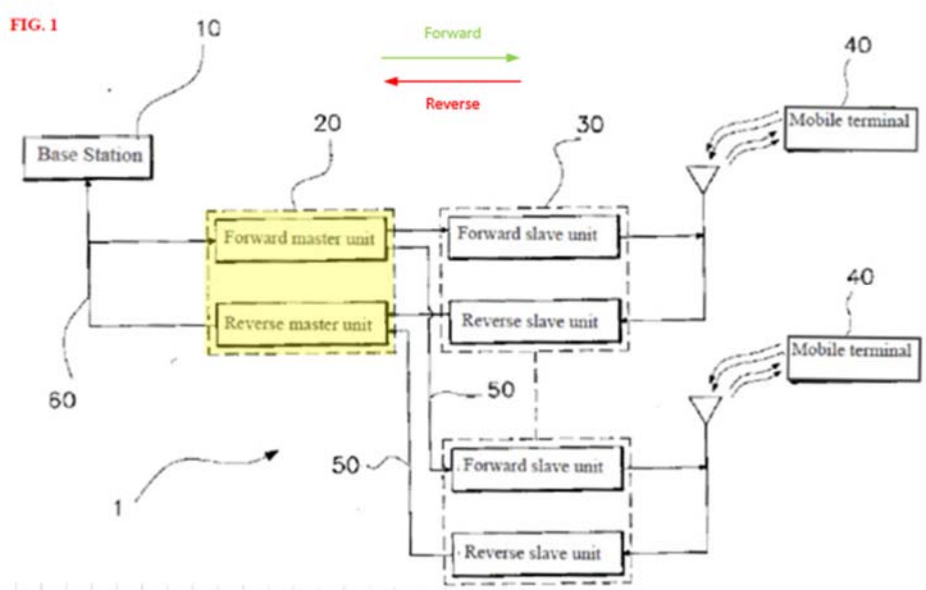
Patent Owner has made clear in a prior litigation that "digital radio frequency (RF)" as that term is used in the '982 patent refers to sampling of any of baseband signals, intermediate frequency signals, or radio frequency signals. *See*, Ex. 1008, Acampora Report, ¶136 ("Accordingly, <u>the baseband digital samples</u>, any intermediate frequency digital samples, and any radio frequency digital samples are all referred to a[s] being digital RF.") Oh's disclosure of A/D conversion (*i.e.*, sampling) of intermediate frequency signals, including signals down converted to close to DC (*i.e.*, baseband signals) is disclosure of digital radio frequency data as that term is used in the '982 patent.

Oh therefore renders obvious each limitation recited in the preamble of claim 1 by disclosing a digital radio frequency (digital samples of intermediate frequency/baseband analog signals) transport system (transmission of those digital signals among the master 20 and slave units 30 across optic lines 50). Ex. 1005, ¶¶98-100.

(b) Element 1: "a digital host unit;"

Element 1 of claim 1 is rendered obvious by Oh.

As discussed above and as shown in Fig. 1, Oh's master unit 20 transmits/receives analog signals to/from the base station and relays digital samples of those analog signals to/from remote slave units 30 across optic lines 50. Ex. 1007, 2:70-3:1; 4:62-64.



Oh's master unit 20 is analogous to the '982 patent's digital host unit (DHU) 20 which interfaces with a wireless interface device (WID) 10 that in embodiments comprises a base station (Ex. 1001, 4:28-29). And like Oh's master unit 20, on the forward path the '982 patents DHU "receives RF signals from WID 10 [*i.e.*, base station] and converts the RF signals to digital RF signals. DHU 20 further optically transmits the digital RF signals to multiple DRUs 40." *Id*.

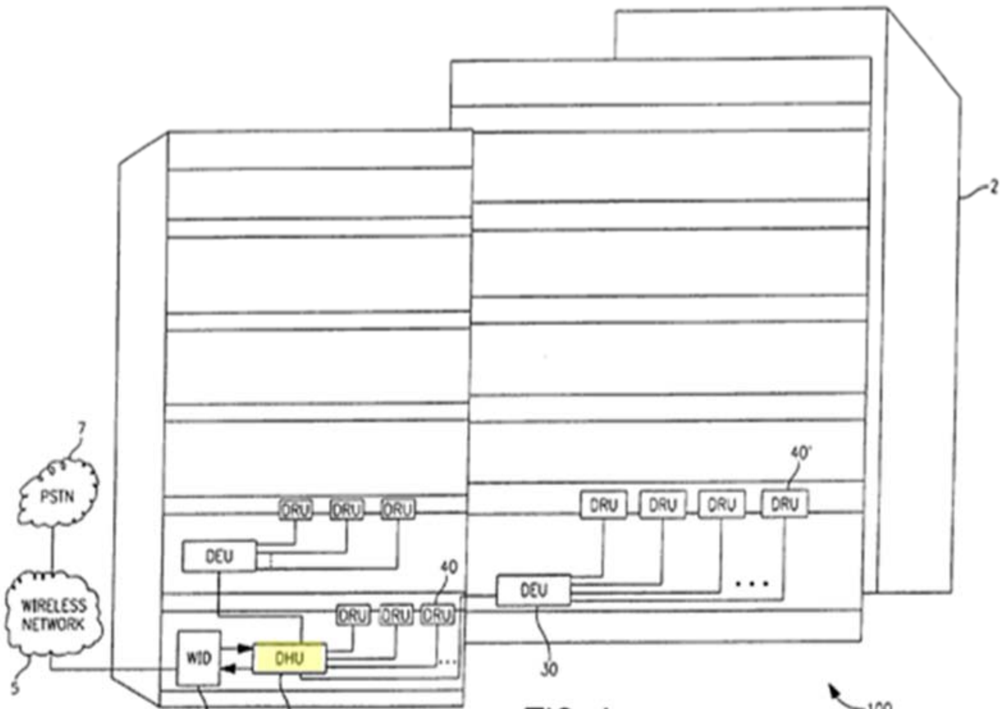


FIG. 1

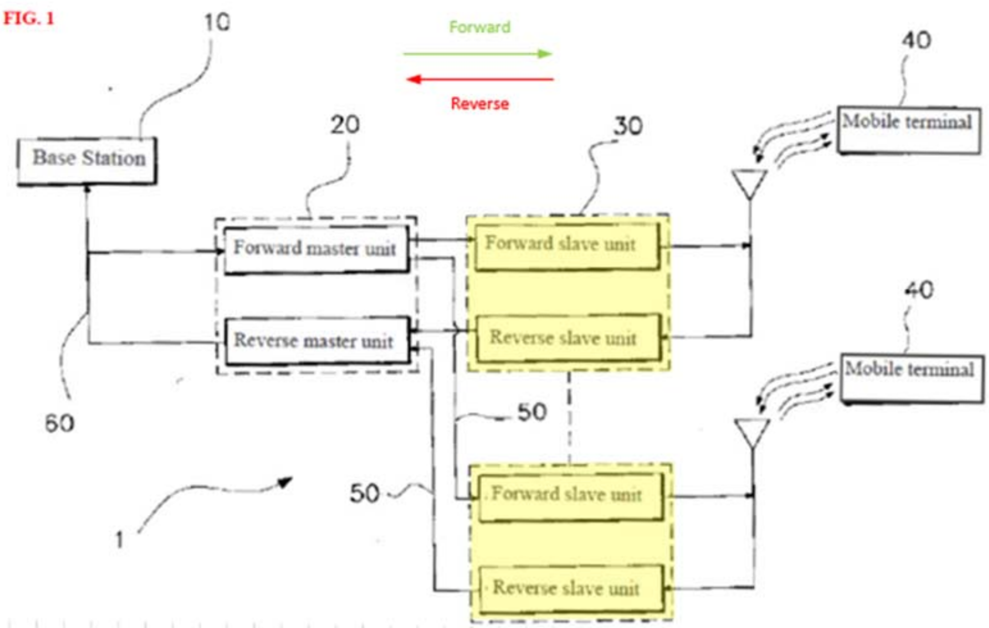
Because Oh's master unit 20 communicates analog signals bi-directionally with a base station, and communicates digital signals bi-directionally with multiple remote units (slave units 30), it is analogous to the host unit described in the '982 patent. Oh renders obvious a digital host unit (master unit 20). Ex. 1005, ¶¶101-103.

(c) Element 2a: "at least two digital remote units coupled to the digital host unit,"

Element 2a is rendered obvious by Oh.

Oh's slave units 30 convert "the digital signals transmitted from the master unit 20 through the optic line 50 to intermediate frequency signals, analog signals; converts them to RF signals and transmits them to the mobile terminals." Ex. 1007, 3:47-49. Oh's slave units 30 further convert analog signals from the mobile terminals 40 to digital signals and transmit them to master unit 20. *Id*., 4:23-25.

FIG. 1



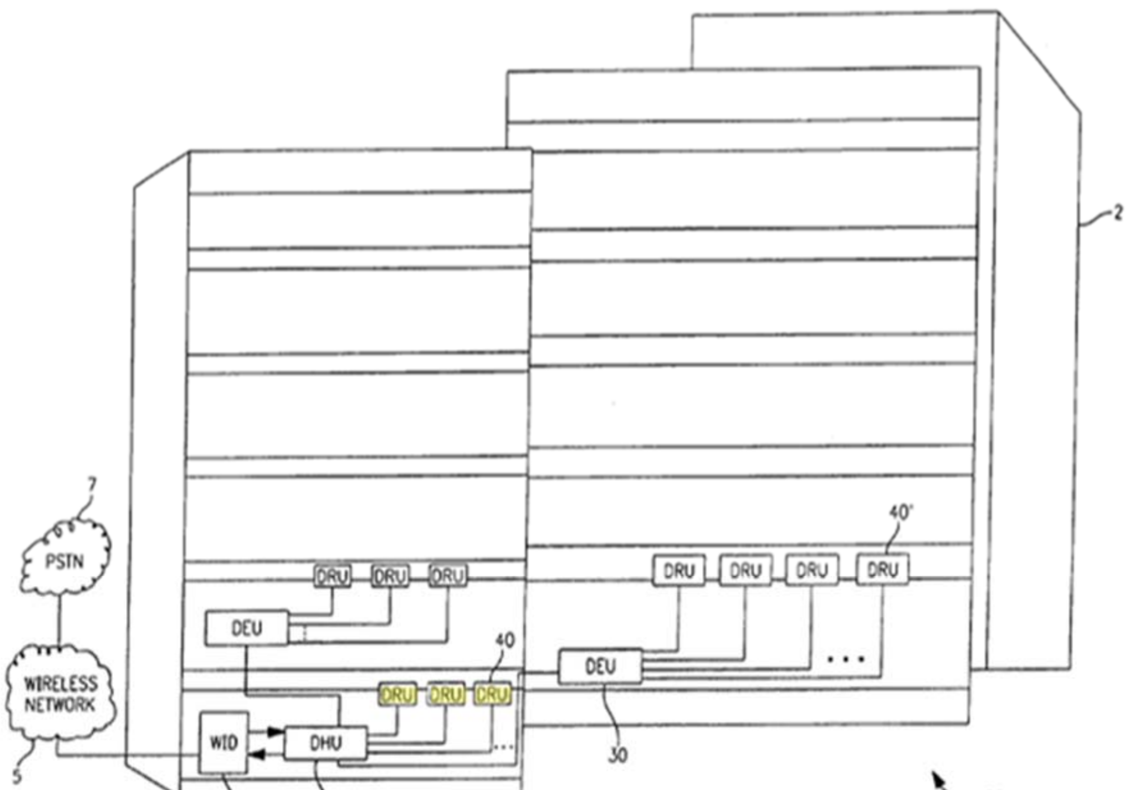


FIG. 1

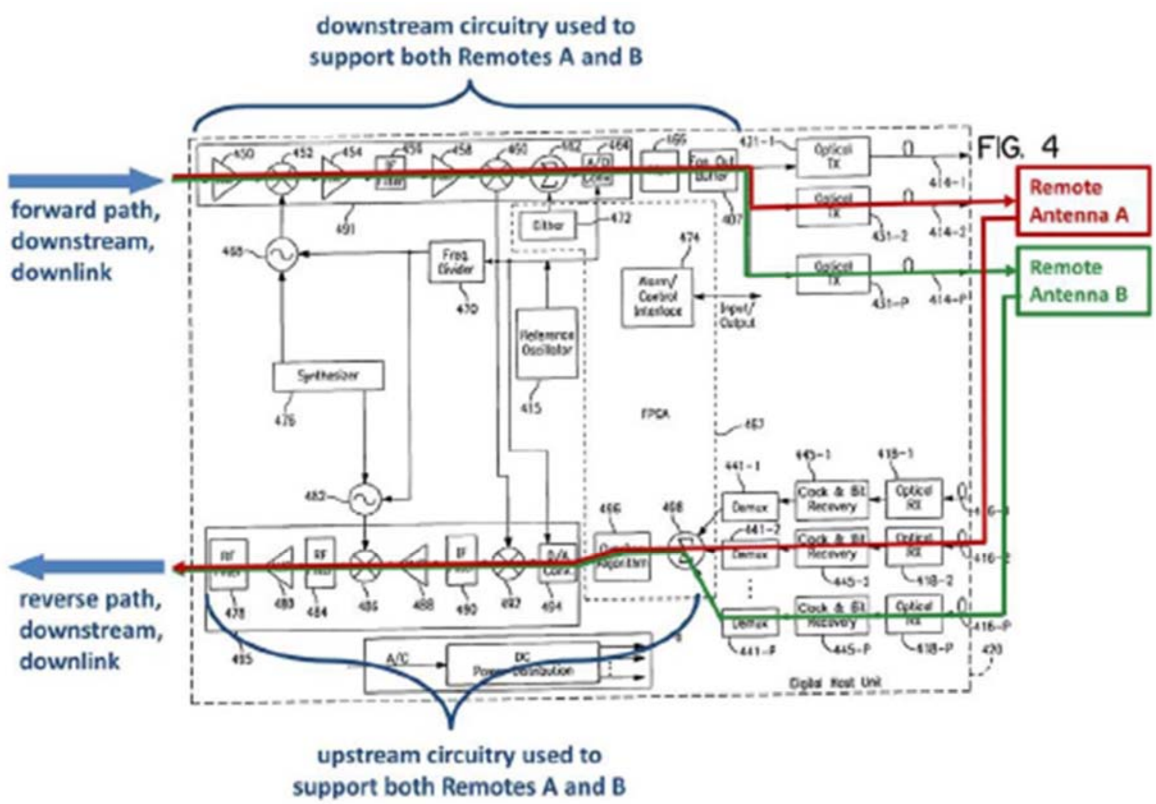
Oh's slave units 30 are analogous to the '982 patent's digital remote units (DRUs) that digitally communicate with the DHU via optic cables (Ex. 1001, 3:61-64) and wirelessly communicate with devices in their area (*e.g.*, via antenna 599).

Oh renders obvious at least two digital remote units (slave units 30) coupled to the digital host unit (master unit 20). Ex. 1005, ¶¶104-105.

(d) Element 2b: "wherein the digital host unit includes shared circuitry that performs bi-directional simultaneous digital radio frequency distribution of digitized radio frequency signals between the digital host unit and the at least two digital remote units;"

Element 2b is rendered obvious by Oh.

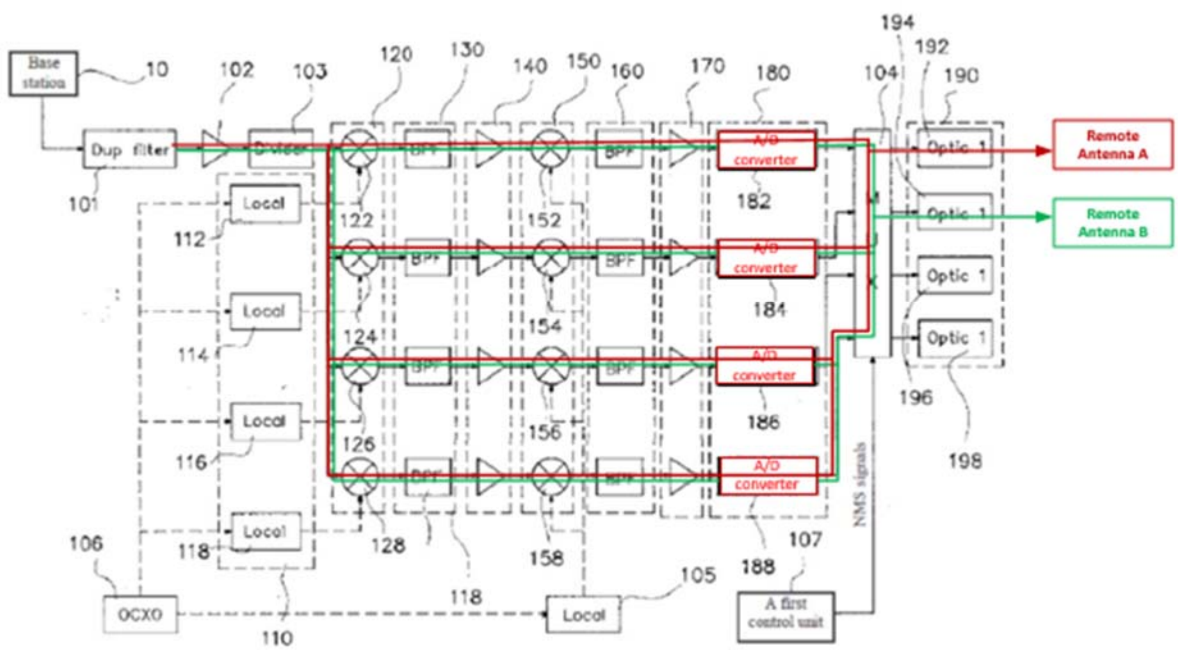
While the ’982 patent’s specification does not use the term “shared circuitry” beyond paraphrases of the claim language, in a prior litigation, Patent Owner has clarified their position that “‘shared circuitry’ was intended to mean circuitry that is used to support more than one remote unit.” Ex. 1008, ¶316. In that same document, Patent Owner illustrated and discussed what it envisioned as the “shared circuitry” at paragraphs 323-324.



There it identified ’982 patent’s “circuitry in box 491, the mux 465, and fan out buffer 431” as the downstream shared circuitry for providing digital radio frequency distribution of digitized radio frequency signals, and “summing unit 498 of the FPGA, the overflow algorithm and circuits of box 495” as the upstream shared circuitry.

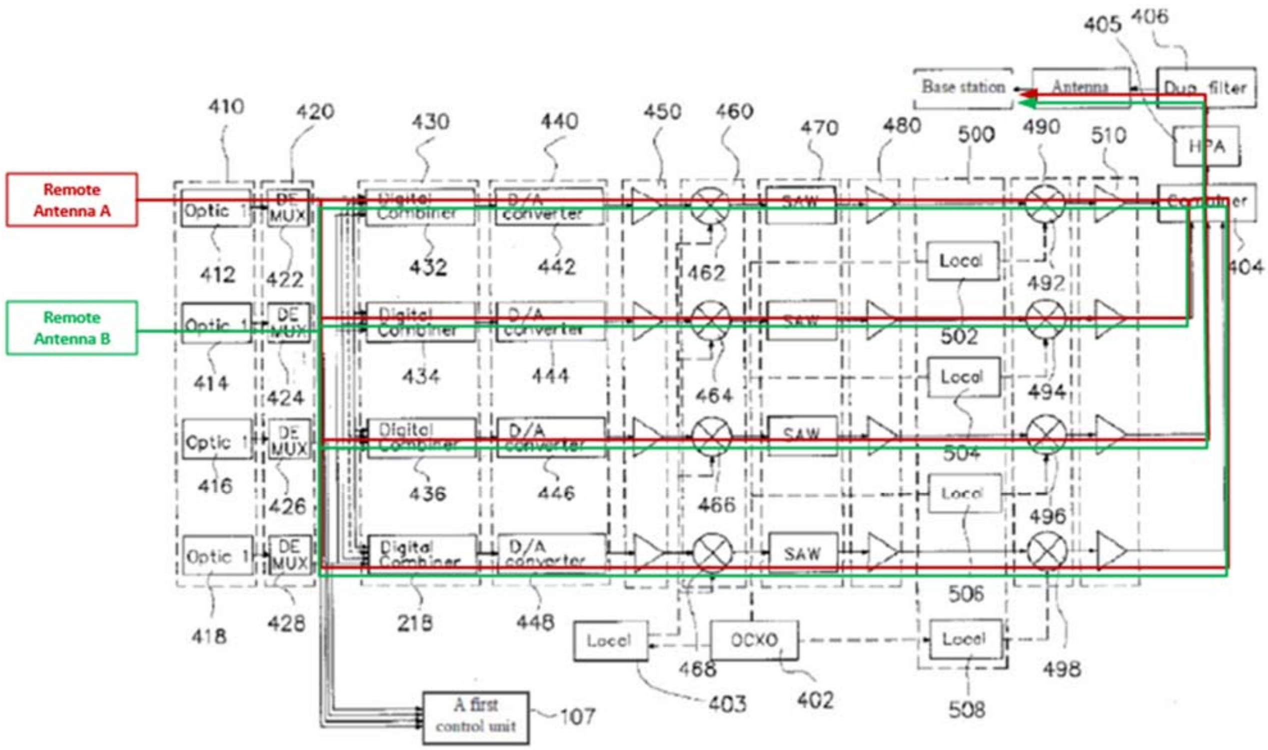
Oh discloses an analogous arrangement of components. On the downstream path of Fig. 2, Oh's circuitry at 120, 130, 140, 150, 160, 170, 180 down converts the analog signals received from the base station to near DC and samples that data, just like the '982 patent's "circuitry in box 491." Oh similarly includes a multiplexer 104 that serializes the digitized data and distributes it to the remote slave units.

FIG. 2



And on the reverse path, Oh's digital combiner unit 430 performs digital combining by aggregating (*i.e.*, digitally summing) digitized radio frequency signals received at master unit 20 from multiple slave units 30 (*see*, Ex. 1007, 4:68-70; 5:16-17; Ex. 1005, ¶58) and then converts the resulting sums to analog signals and processes those analog signals to generate a signal at 404 (*i.e.*, analog combining) that represents all of the data received from the multiple slave units 30 (*i.e.*, an output RF signal containing the same information contained in the '982 patent's RF output).

FIG. 5



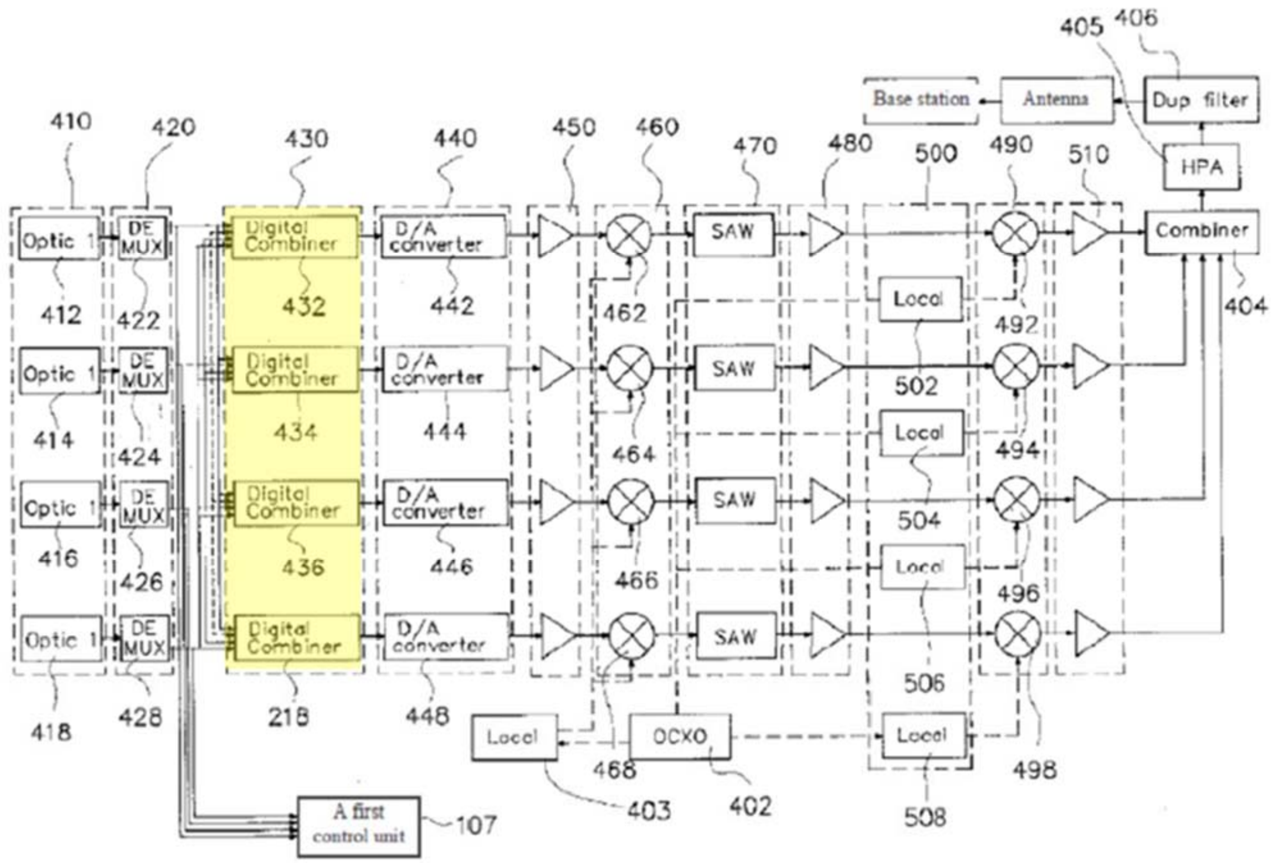
Oh renders obvious the digital host unit (master unit 20) includes shared circuitry (downstream 104, 120-190; upstream 420-510, 404) that performs bi-directional simultaneous digital frequency distribution (signals transmitted from 190 and at the same time, signals received at 430 at the same time) of digitized radio frequency signals (intermediate frequency signals sampled at master unit at 180 and slave units at 380) between the digital host unit (master unit 20) and the at least two digital remote units (slave units 30). Ex. 1005, ¶¶106-110.

(e) Element 3: "wherein the digital host unit digitally sums the digitized radio frequency signals received at the digital host unit."

Element 3 of claim 1 is rendered obvious by Oh.

Oh's master unit 20 includes a digital combiner unit 430 that performs digital combining by aggregating digital signals transmitted from each demultiplexer 422, 424, 426, 428 of demultiplexer unit 420. Ex. 1007, 4:68-70; Ex. 1005, ¶58.

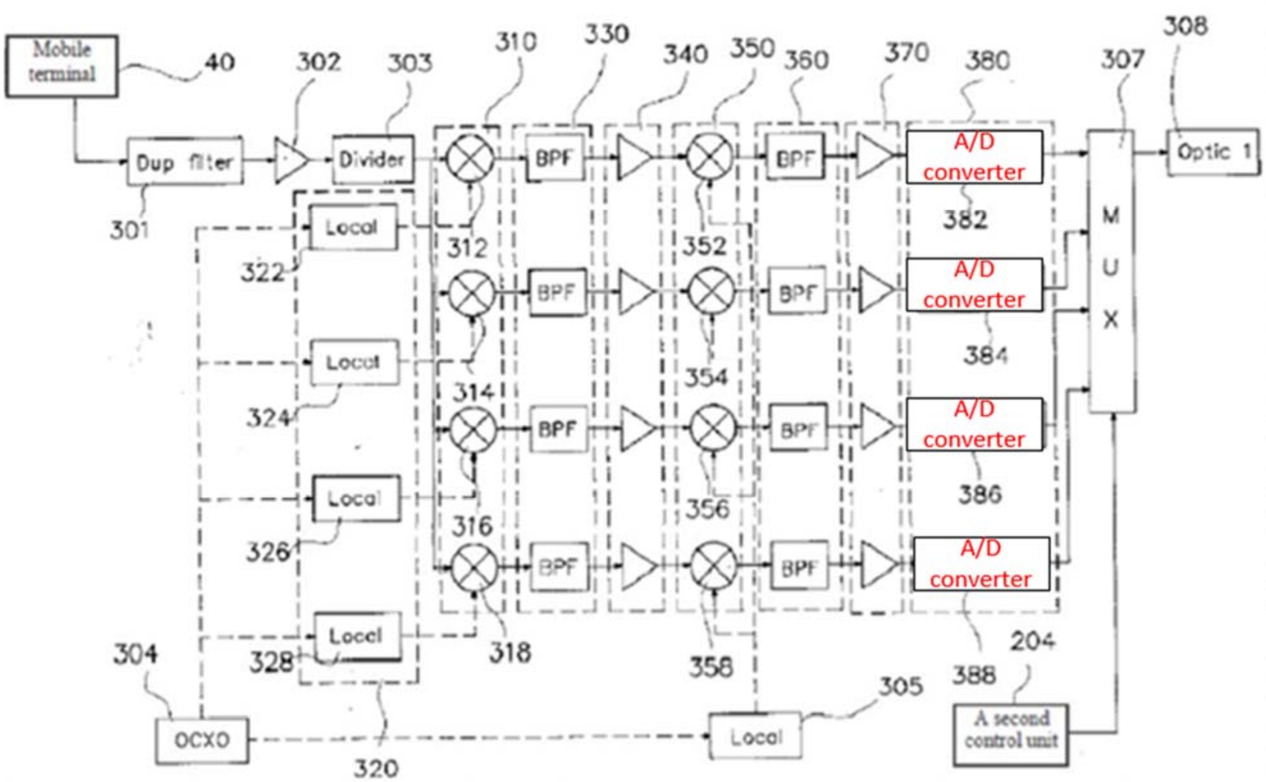
FIG. 5



Those demultiplexers at 420 receive data from individual remote slave units 30 at 410.

As depicted in Fig. 4, each slave unit 30 receives an analog signal from mobile terminals 40, divides the received analog signal into its component frequency bands at 303 and downconverts the frequency band signals to near DC at 310-370. Ex. 1007, 4:26-34. The downconverted band signals are then sampled at 380 to create 12-bit digitized radio frequency signals. *Id.*, 4:56-61. The multiplexer 307 multiplexes the four 12-bit samples with 4 bits of control data from 204 to form 52-bit serial data signals that are forwarded to master unit 20. *Id.*

FIG. 4



Referring back to Fig. 5, each demultiplexer 422, 424, 426, 428 receives a 52-bit signal from its respective slave unit 30. Each demultiplexer forwards 12-bits of sample data to the appropriate digital combiner associated with the proper frequency band for that 12-bit sample and forwards its 4 bits of control data to control unit 107. Upon receiving four 12-bit signals (one from each of demultiplexer 422, 424, 426, 428), each digital combiner 432, 434, 436, 438 performs digital combining on those 12-bit signals to "creat[e a] 14-bit intermediate frequency signal[] by combining[1] four 12-bit intermediate frequency signals in the same frequency band." Ex. 1005, ¶80 (Dr. Baker testifying that whether referred to as "adding," "aggregating," or "combining," the result of digital combiners 432, 434, 436, 438 processing of the four 12-bit signals to create a 14-bit signal is a "digital sum:" *e.g.*, 1010 1010 1010 (2,730) + 1100 1100 1100 (3,276) + 1111 1111 1111 (4,095) + 0000 1100 1100 (204) = 10 1000 0100 0001 (10,305)); Ex. 1007, 5:16-17.[2] Those 14-bit signals are then converted to analog signals at 440, upconverted, combined (*i.e.*, analog combining), and transmitted to the base station 10. *Id.*, 5:17-29; Ex. 1005, ¶58.

Oh renders obvious the digital host unit (master unit 20) digitally sums the

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[1] The translation originally commissioned by SOLiD translated this word as "added." In parallel litigation in the UK, CommScope requested that it be translated as "combined." The translator is agreeable to using "combined," and that is reflected in Ex. 1007 submitted herewith.

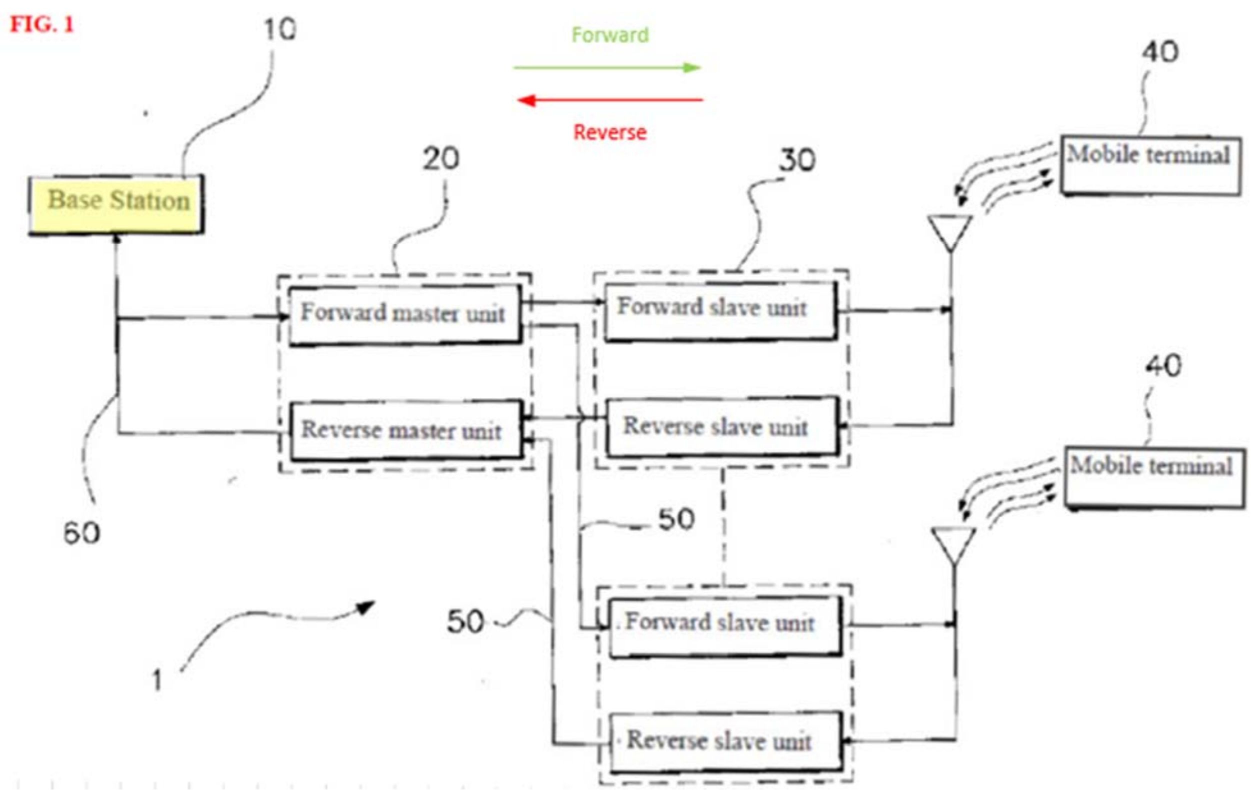
[2] This is evidenced by the CommScope patents themselves referring to their "sum" operation as "combining." *See*, Ex. 1001, 4:67-5:16 ("Both DHU and DEU split signals in the forward path and **sum signals in the reverse path**…Splitting and **combining** the signals in a digital state avoids the combining and splitting losses experienced with an analog system.")

digitized radio frequency signals (creates 14-bit signals by combining four 12-bit signals) received at the digital host unit.

Oh therefore renders obvious each limitation recited in claim 1. Ex. 1005, ¶¶111-114.

2. Dependent Claim 2

The '982 patent states that in one embodiment a wireless interface device comprises a base station. Ex. 1001, 4:28-30. Fig. 1 of Oh depicts a base station 10 coupled to master unit 20.



Oh renders obvious a wireless interface device (base station 10) coupled to the digital host unit (master unit 20). Ex. 1005, ¶115.

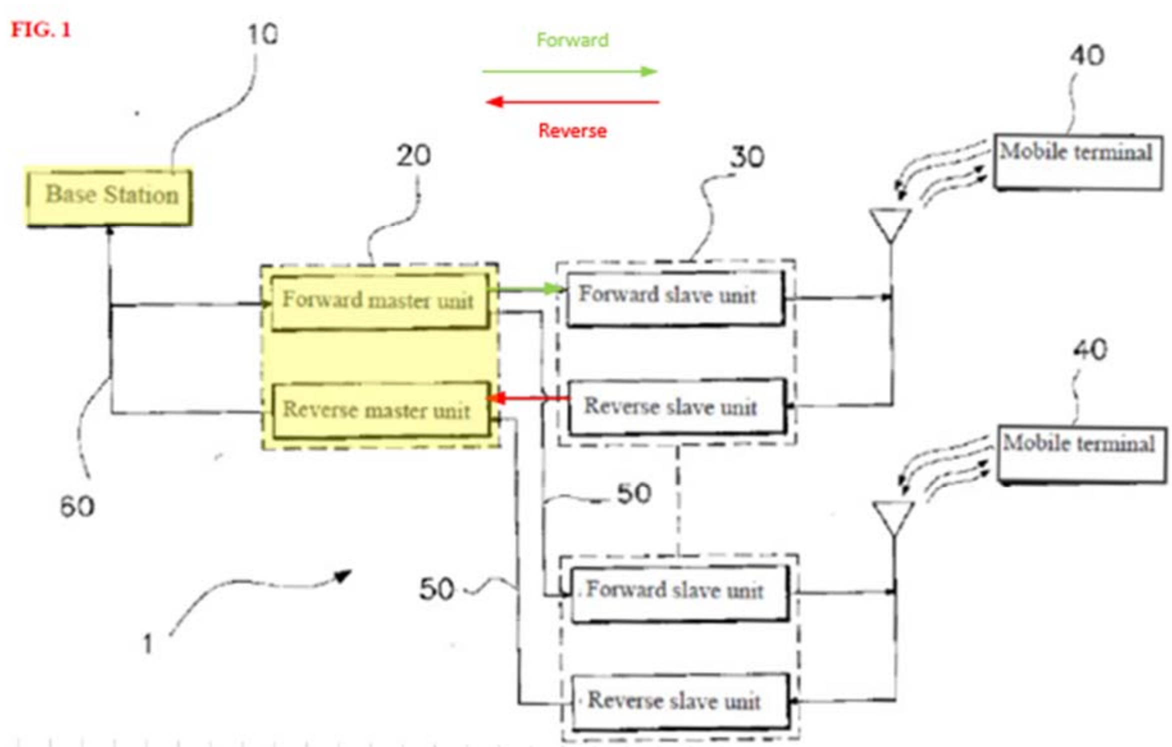
3. Dependent Claim 3

Oh discloses that RF signals are transmitted from base station 10 to master unit 20 through "RF cable." Ex. 1007, 2:71-72. A POSITA in July 2000 would have understood a reference to RF cable to mean coaxial cable. Ex. 1005, ¶116, *see also*, Ex. 1025, 1:27-29.

Oh renders obvious the wireless interface device comprises a base station (10) that couples directly to the digital host (30) unit via coaxial cables (RF cable). Ex. 1005, ¶116.

4. Dependent Claim 4

As discussed above in addressing claim 2, Oh discloses that its master unit 20 bi-directionally communicates with base station 10.



Figs. 2 and 5 illustrate that those bi-directional communications are via a bi-directional amplifier, where Oh's master unit 20 communicates with the base station 10 via a bi-directional filter 101, 406 connected to amplifiers 102, 405.

FIG. 2

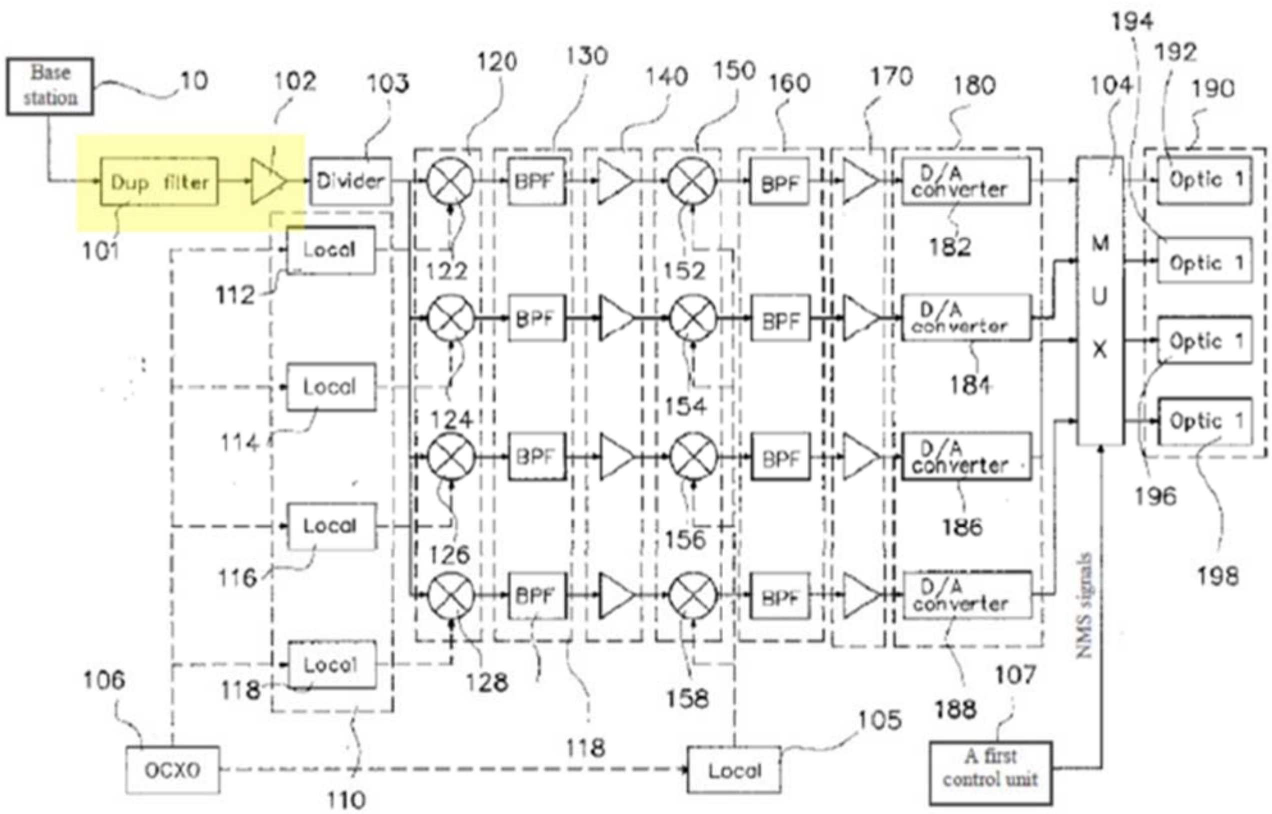
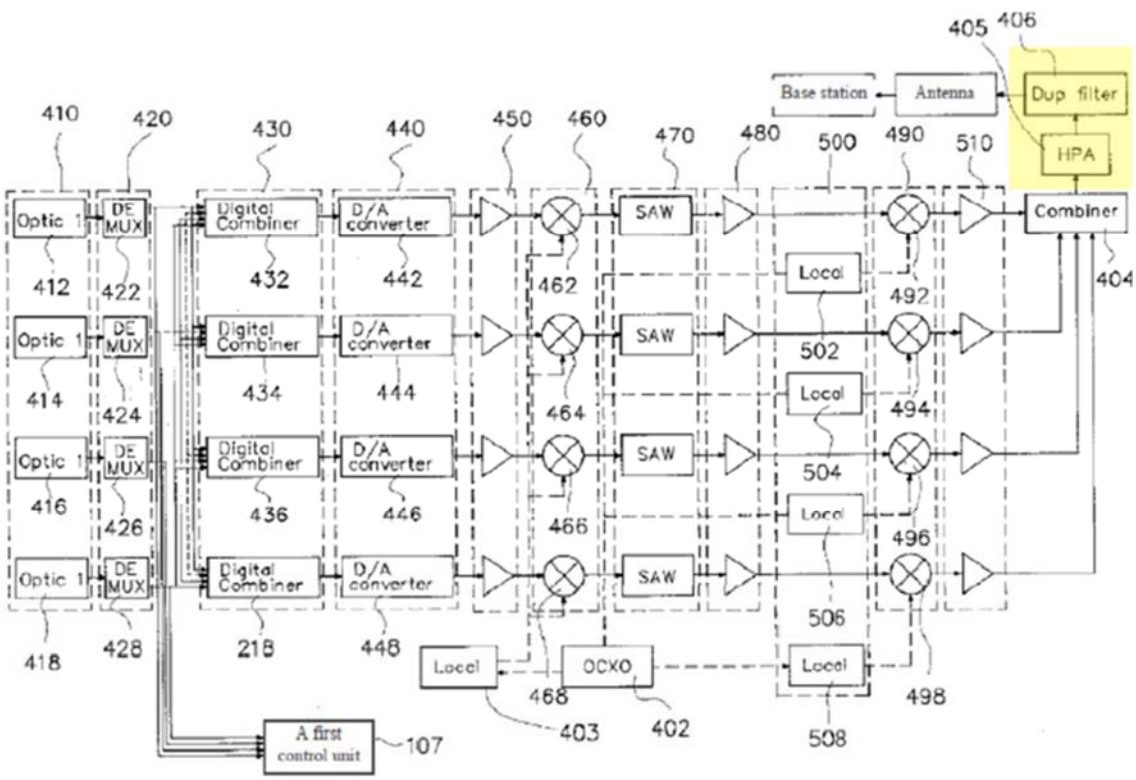


FIG. 5

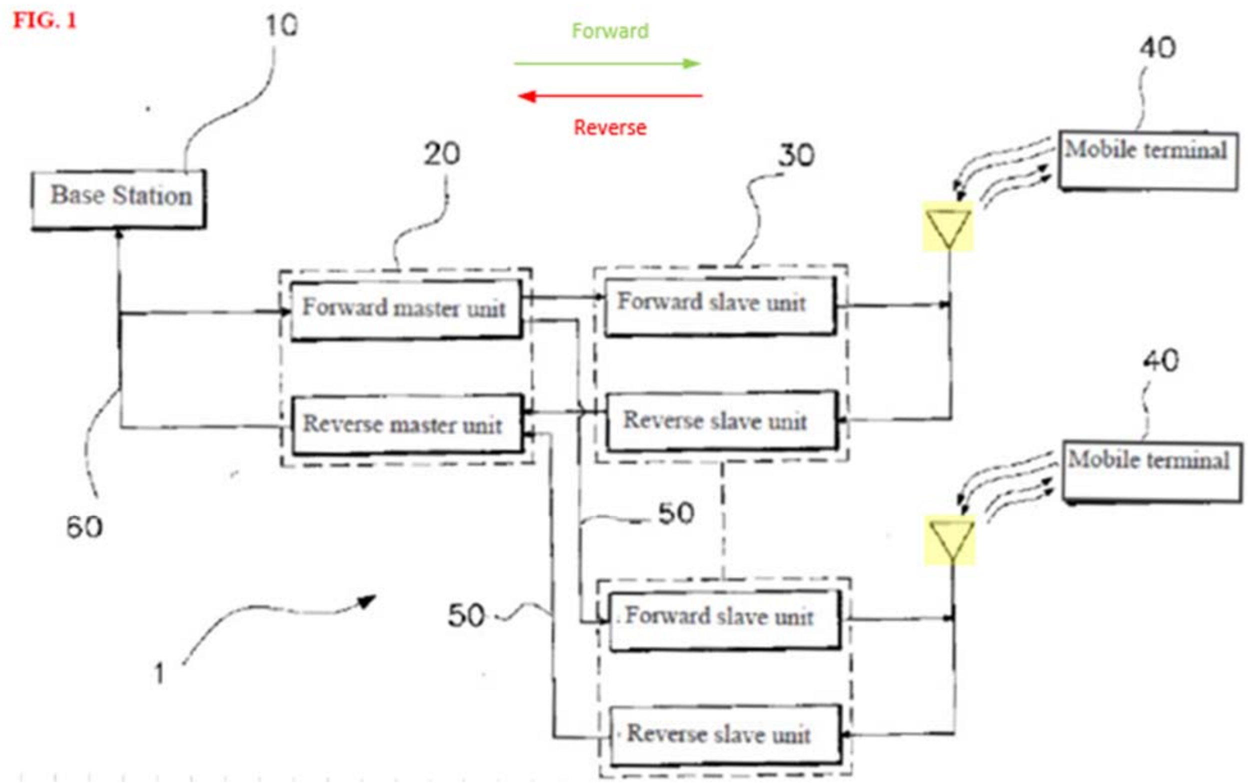


A POSITA understands that a bi-directional amplifier comprises a bi-directional duplex filter component to prevent the transmit signal from interfering with the receive channel and an amplifier component. Fig. 5 of Oh illustrates its bi-directional filter 406 being connected to an antenna for wireless communication with the base station 10.

Oh renders obvious the wireless interface device comprises a base station (10) that wirelessly connects (*see*, Fig. 5 Antenna) to the digital host unit (master unit 20) via a bi-directional amplifier (101, 102, 405, 406). Ex. 1005, ¶¶117-119.

5. Dependent Claim 5

Fig. 1 of Oh depicts two slave units 30, each of which has an antenna that is depicted as transmitting signals to and receiving signals from mobile terminals. Oh explicitly says that the transmitted and received signals are RF. Ex. 1007, 3:59-61; 4:16-19.

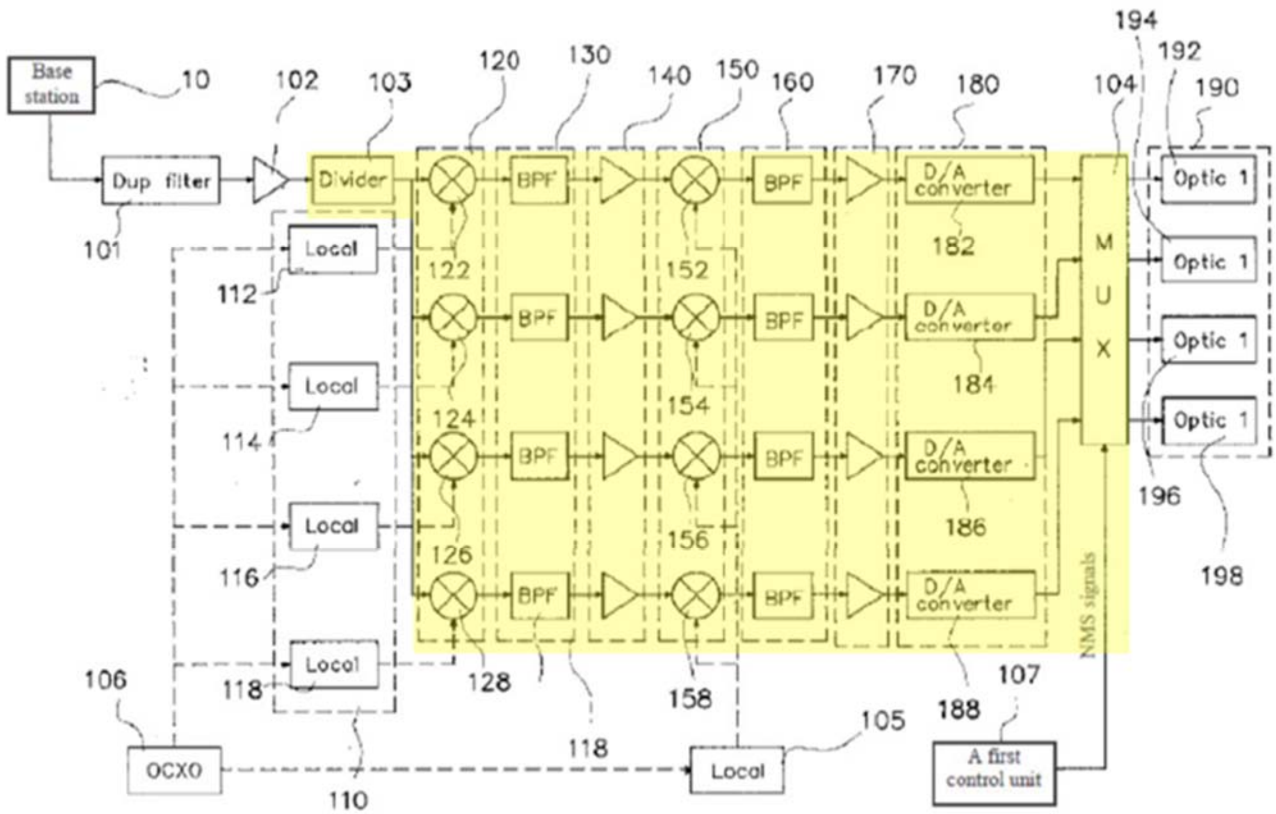


Oh renders obvious at least two digital remote units (slave units 30) each include a main radio frequency antenna which transmits and receives radio frequency signals. Ex. 1005, ¶¶120-121.

6. Dependent Claim 6

Fig. 2 of Oh depicts the master unit 20 that receives a radio frequency signal and outputs digital representation of the received radio frequency signal.

FIG. 2



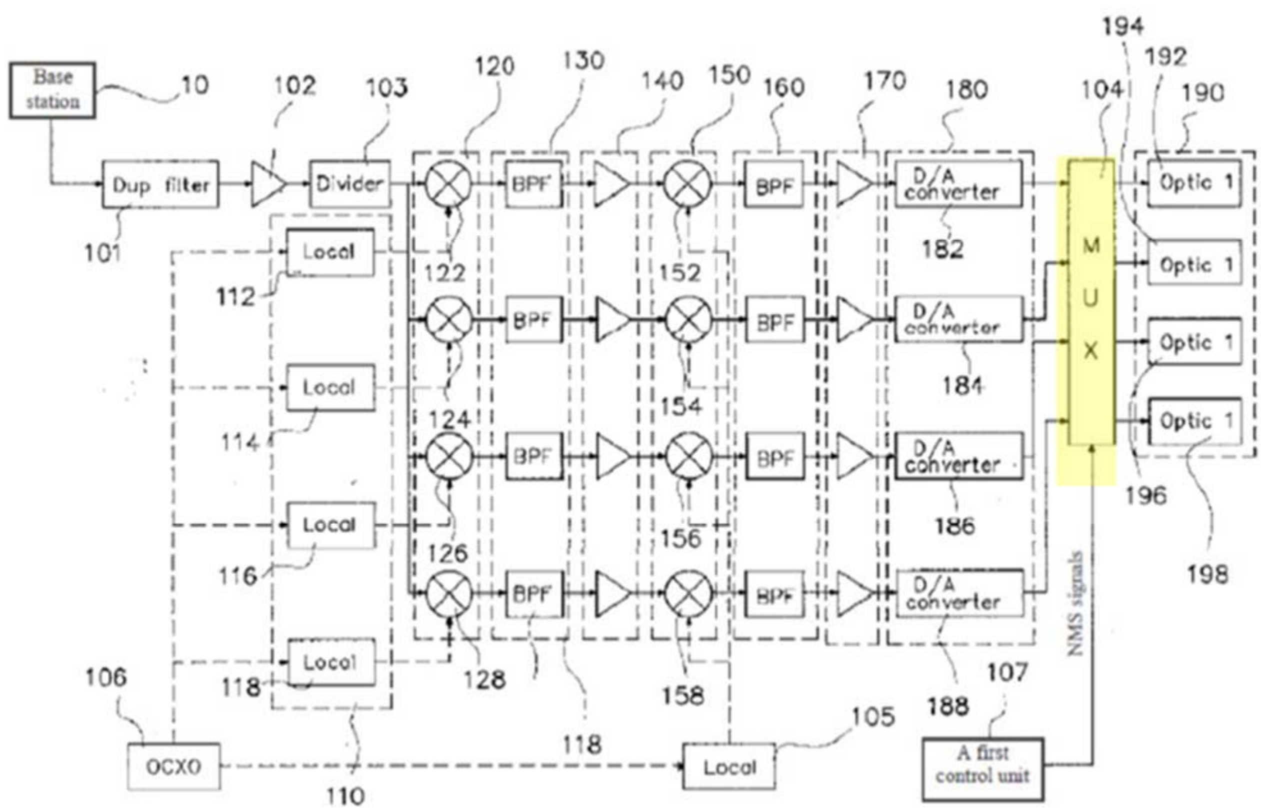
As described at 3:6-18, a first divider 103 divides the received RF signal among 4 rows of frequency band digitization circuitry. The frequency band signals from the divider are downconverted 120, filtered 130, amplified 140, further downconverted 150, further filtered 160, and further amplified 170 before being sampled at 180 to create a digital representation of the received main radio frequency signal in the form of four 12-bit samples, one from each frequency band path. The multiplexer 104 multiplexes those four 12-bit samples, which together represent the main radio frequency signal received from the base station 10, and 4 bits of control data 107 that is transmitted to the remote slave units 30.

Oh renders obvious the digital host unit (master unit 20) includes a radio frequency to digital converter (103, 120-180, 104) that converts a main radio frequency signal (received from base station 10) to at least a portion of the digitized radio frequency signals (output from mux 104 to remote slave units 30). Ex. 1005, ¶¶122-124.

7. Dependent Claim 7

Fig. 2 of Oh depicts master unit 20's multiplexer 104. Multiplexer 104 receives the 12-bit samples from the A/D converter unit 180 and multiplexes them along with the control data from 107 and outputs copies of those 52-bit signals to four remote slave units 30 via optic converters depicted at 190. Ex. 1007, 3:16-19.

FIG. 2

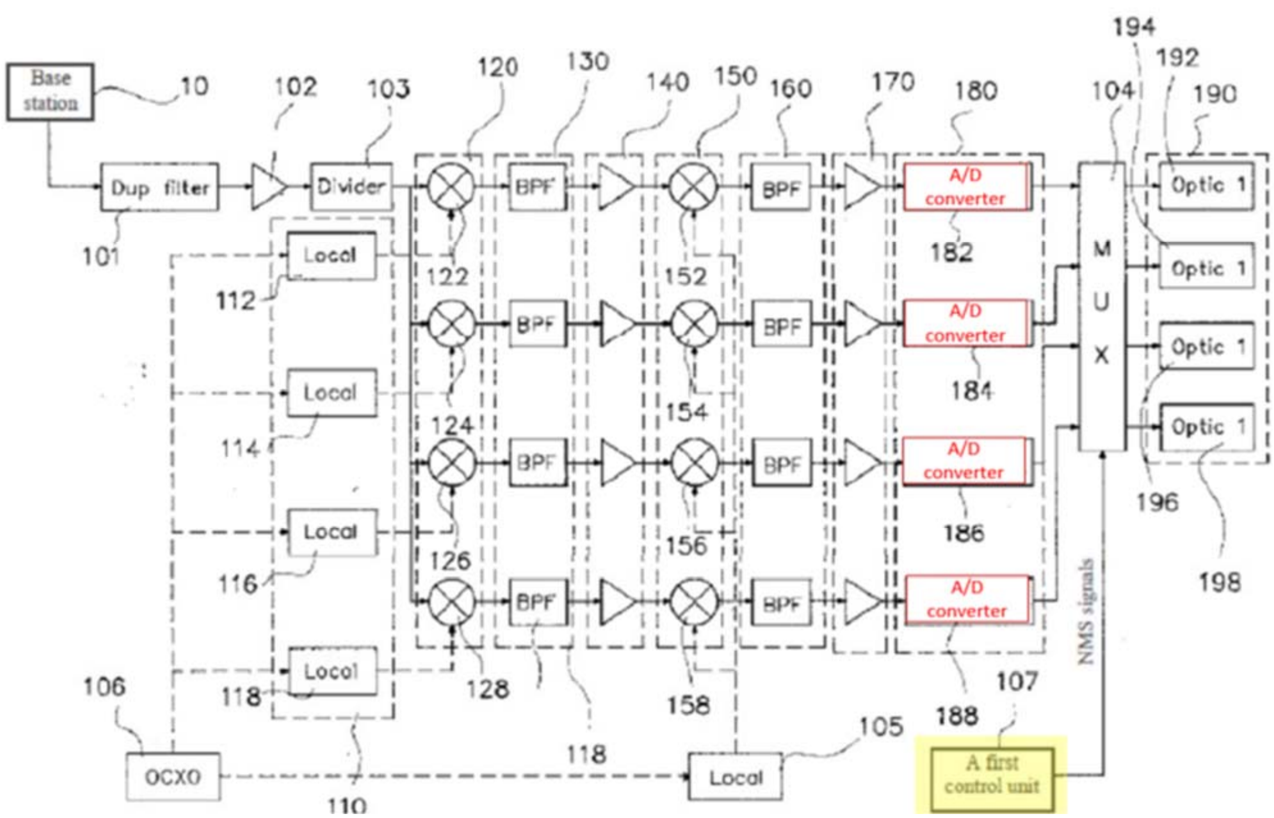


Oh renders obvious the digital host unit (master unit 20) further includes a multiplexer (104) which splits the digitized radio frequency signals (52-bit signals) into at least two digital signals (mux 104 splits for transmission on 192, 194, 196, 198) for optical transmission to the at least two digital remote units (remote slave units 30). Ex. 1005, ¶¶125-126.

8. Dependent Claim 8

Fig. 2 of Oh depicts first control unit 107 that is coupled to multiplexer 104. That control unit 107 appends 4 bits of NMS (Network Management System) control data to each set of digital sample data transmitted across optic lines 50.

FIG. 2

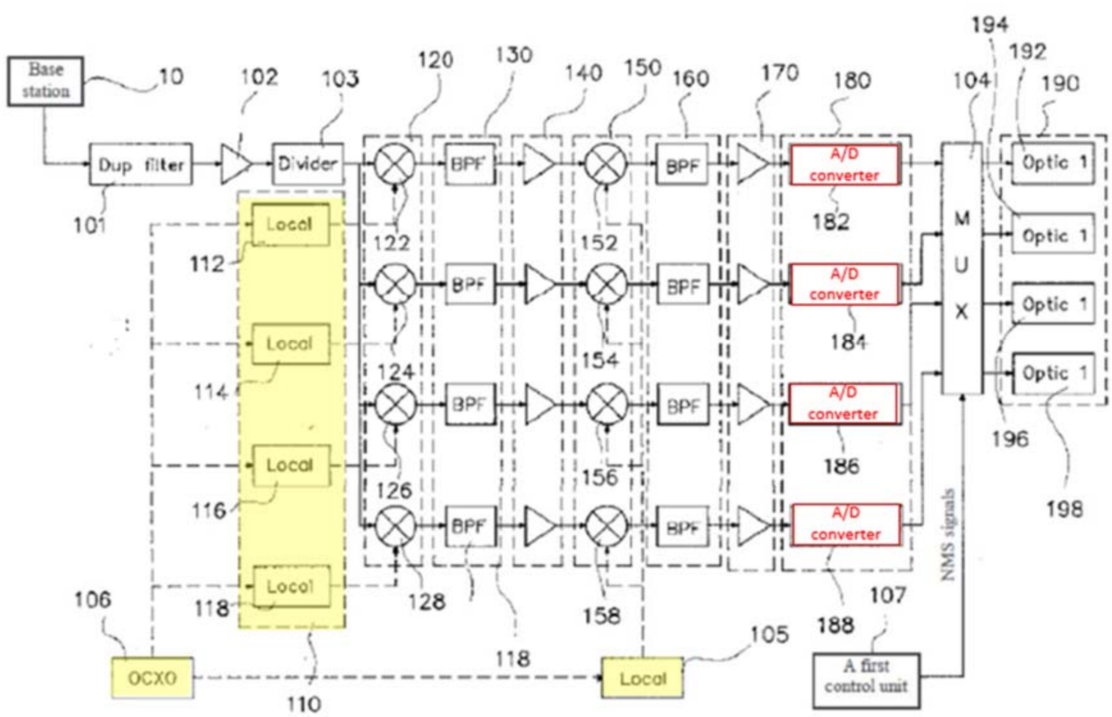


Oh renders obvious the digital host unit (master unit 20) further comprises an alarm/control interface circuit (first control unit 107) coupled to the multiplexer (104). Ex. 1005, ¶¶127-128.

9. Dependent Claim 9

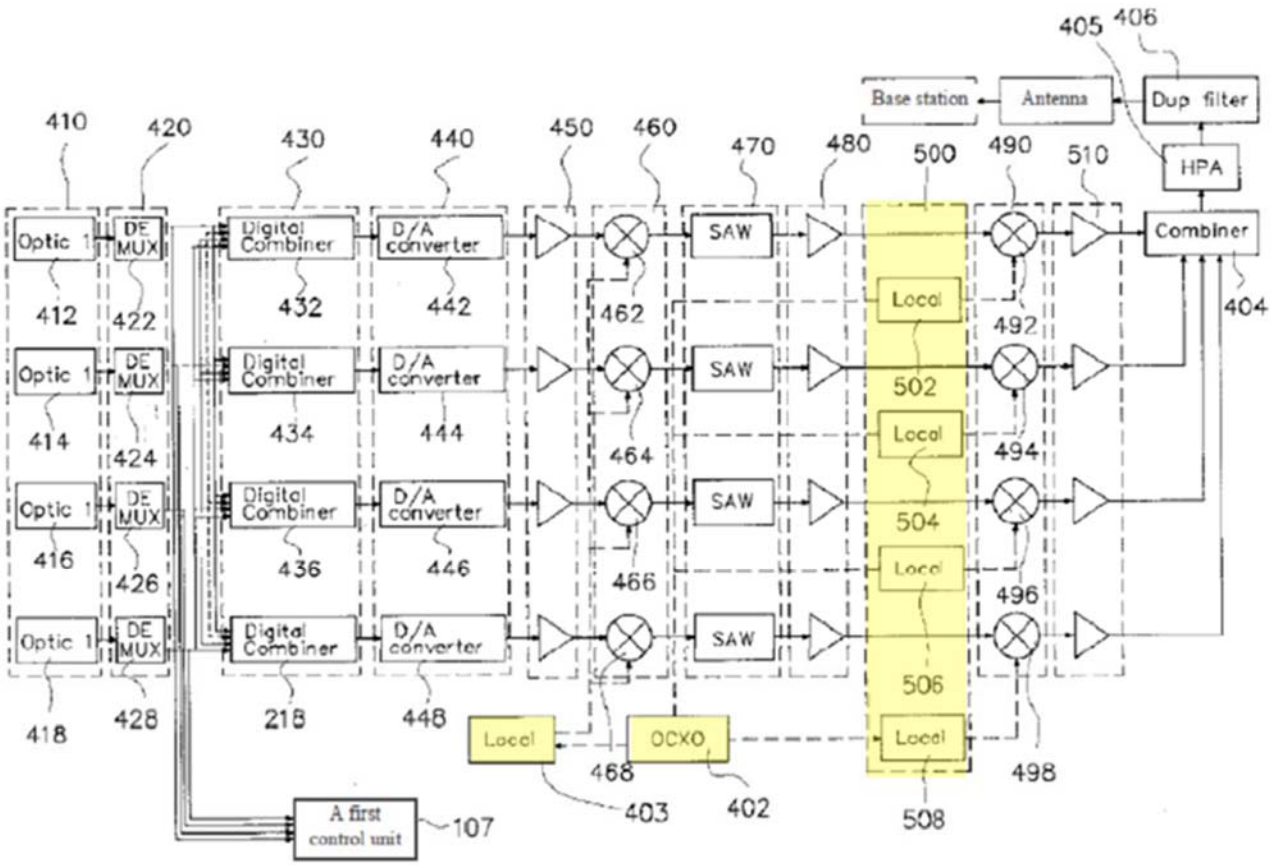
Oh discloses that master unit 20 includes local oscillators 112, 114, 116, 118 (for converting from 801.23, 803.69, 806.15, 808.61 to 70Mhz: Ex. 1007, 3:20-25), and 105 (for converting from 70MHz to near DC: Ex. 1007, 3:34-37), coupled to oven-controlled reference oscillator 106 in the forward direction of Fig. 2.

FIG. 2



And Oh discloses that master unit 20 includes local oscillators 403 (for converting from near DC to 70 MHz: Ex. 1007, 5:19-22), 502, 504, 506, 508 (for converting from 70 to 801.23, 803.69, 806.15, 808.61 Mhz: Ex. 1007, 5:23-26) coupled to oven-controlled reference oscillator 402 in the forward direction of Fig. 2.

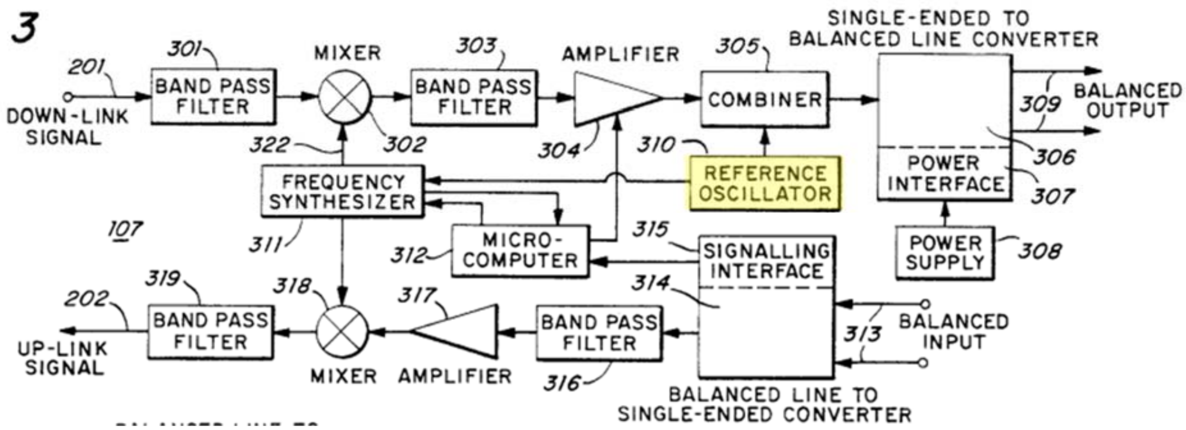
FIG. 5



Oh's disclosure of oven controlled reference oscillator (106 in Fig. 2, 402 in Fig. 5) in master unit 20 teaches the limitation. To the extent that Oh is not explicit that reference 106 in Fig. 2 and 402 in Fig. 5 are indicating the same reference oscillator, such an implementation would be obvious to a POSITA. Because the forward and reverse frequency translations are to the same frequencies (*i.e.* 70MHz to/from about 800MHz; near DC to/from 70MHz), the local oscillators operating in Figs. 2 and 5 will be operating at the same frequencies. Having those common local frequencies being generated in Figs. 2 and 5 using a single, common oven-controlled reference oscillator would have been an obvious design choice because using a single reference oscillator would have reduced part count (and associated cost), reduced power consumption, and reduced reliability concerns caused by additional moving parts that would be present if discrete reference oscillators were used. As illustrated in Figs. 2 and 5 already, a single reference oscillator can be used to generate several local frequency signals. Thus implementing master unit 20 with a single reference oscillator 106/402 would have been obvious.

To any extent that the use of a common reference oscillator is deemed not within the general skill of the art, a POSITA would have been motivated to implement a common reference oscillator for forward and reverse direction operations as disclosed in van der Kaay (Ex. 1019), where a common reference oscillator 310 is used to generate frequencies for frequency shifting operations in the forward and reverse directions. A POSITA would be motivated to combine the disclosures because use of a common reference oscillator would reduce part count (and associated cost), reduce power consumption, and reduce reliability concerns caused by additional moving parts that would be present if discrete reference oscillators were used. Further "[s]ince the same reference oscillator signal (representative of the output of the referenced oscillator 310) is used throughout the RF signal distribution system, frequency accuracy is maintained at a high level." Ex. 1019, 9:62-65.

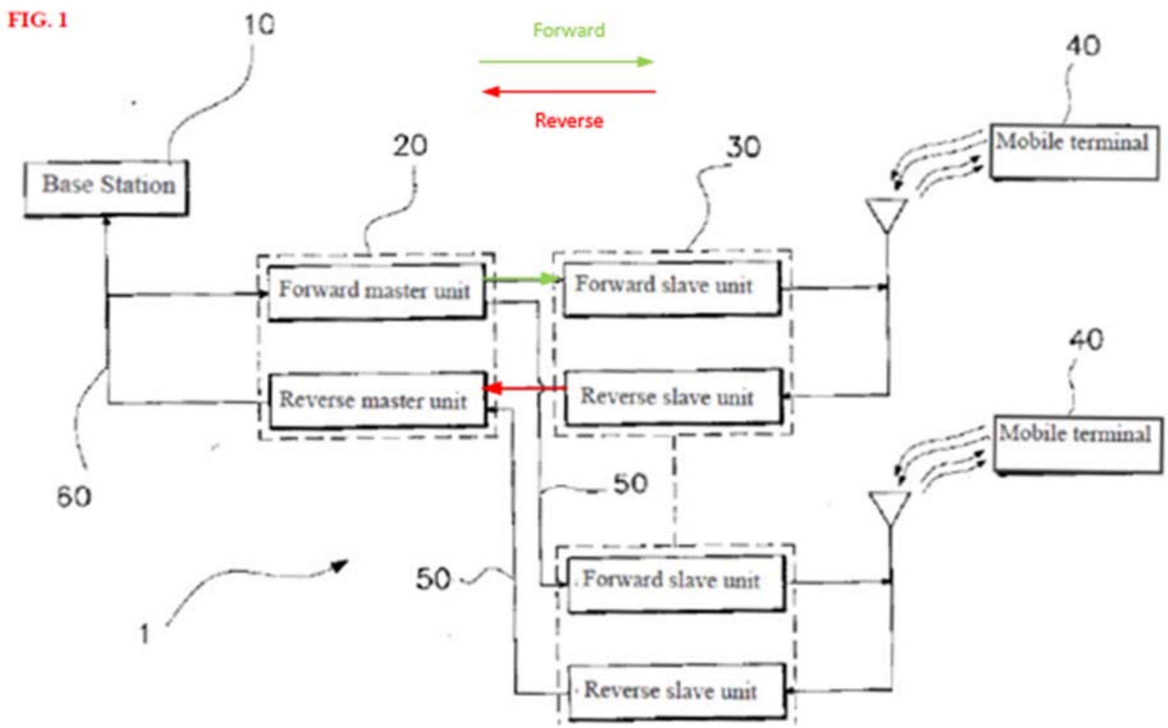
FIG. 3



Oh renders obvious the digital host unit (20) includes local oscillators (105, 112, 114, 116, 118, 403, 502, 504, 506, 508) coupled to a reference oscillator (106/402) for synchronization of the radio frequency signal in the forward direction (Fig. 2) and the reverse direction (Fig. 5). Ex. 1005, ¶¶129-132.

10. Dependent Claim 10

Oh Fig. 1 illustrates master unit 20 communicating in the forward direction to a slave unit 30 using a first optic line 50, highlighted in green, and in the reverse direction from a slave unit using a second optic line 50 highlighted in red. Oh discloses master unit 20 communicating with each slave unit 30 via fiber pairs.



Oh discloses that the master unit 20 communicates digital data to slave units 30 via optic lines 50. Ex. 1007, 3:4-6. Oh is agnostic as to whether multimode or single mode fiber is used. A POSITA would consider selection of multimode or single mode to be a matter of design choice. This is evidenced by Farber which describes the use of single or multimode fiber in an antenna system for reaching difficult coverage areas (*see*, Fig. 1) that is very similar to the digital system of Oh. Ex. 1022 ("Farber"), 4:30-33 ("Preferably the transmitter 14 employs a vertical cavity surface emitting laser or an edge emitting laser coupled to a single or multi-mode fiber 16."); Fig. 2. As further evidence of obviousness of using multimode fiber, Haas illustrates the cost-benefit analysis of selection of multimode or single mode fiber for an application. Ex. 1012, 1125. A POSITA would have been motivated to select multimode fiber as disclosed by Haas for communicating among a host and remote units when cost is a significant factor for the project. Additionally as disclosed by Haas, in some instances multimode fiber may already be installed in an area into which an RF distribution network is being implemented, making reuse of that multimode fiber an attractive option.

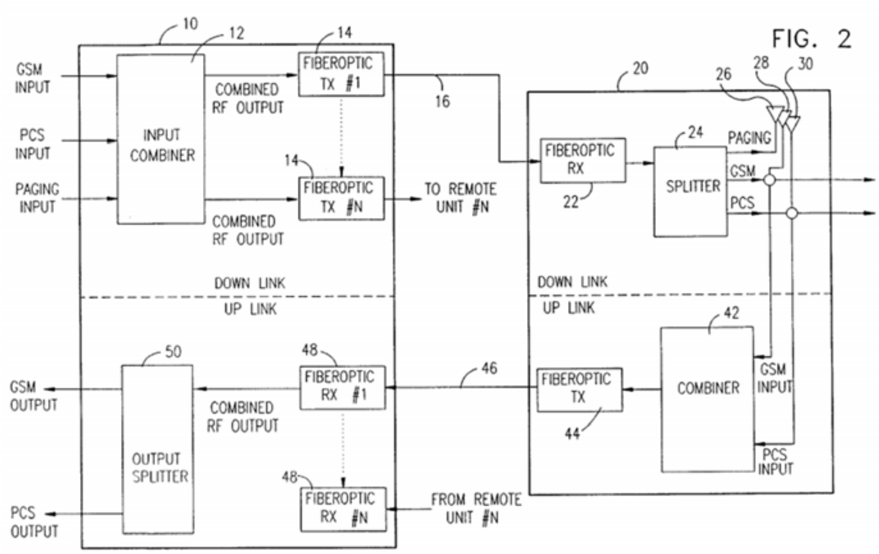


FIG. 2

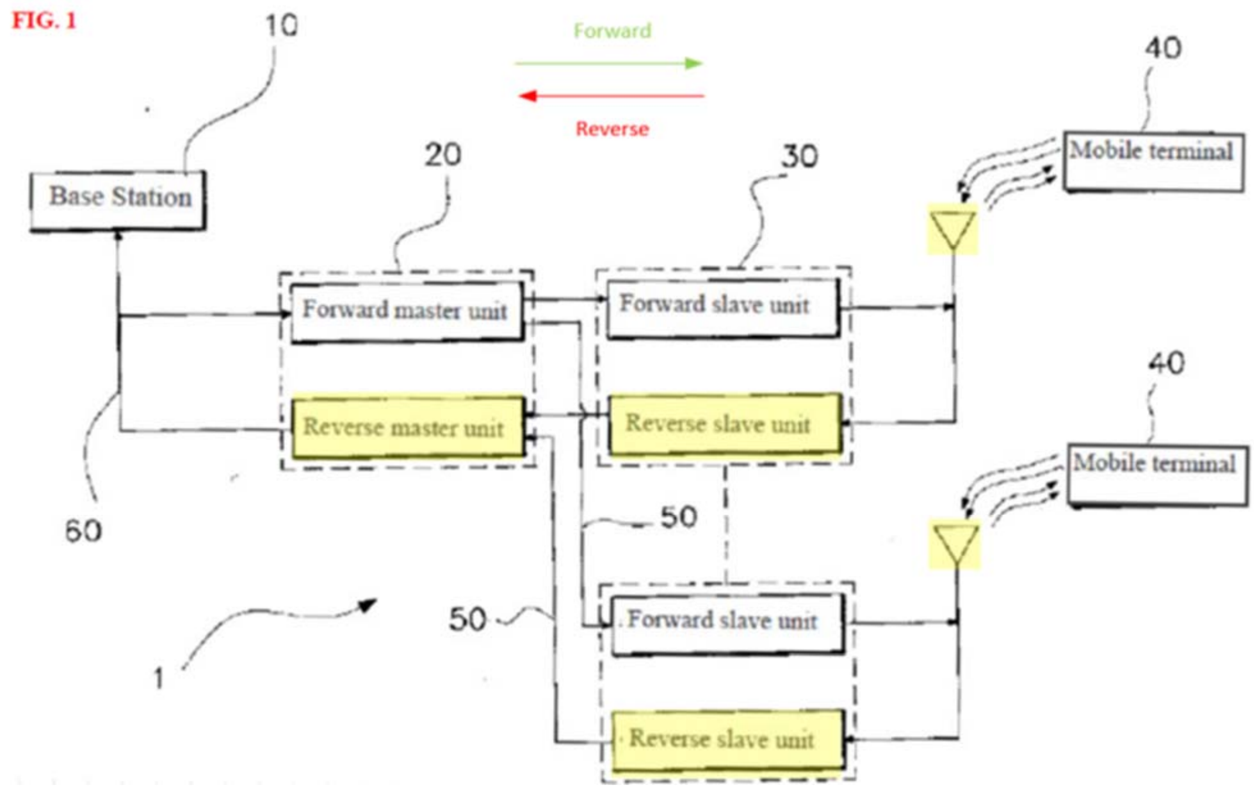
Oh alone, or in view of Farber, renders obvious the digital host unit 20 is coupled to each of the at least two digital remote units 30 by a multimode (*e.g.*, as disclosed by Farber) fiber pair (*see*, red and green annotations between 20, 30 in Oh Fig. 1). Ex. 1005, ¶¶133-135.

11. Independent Claim 25

(a) Preamble

To the extent the preamble of claim 25 is limiting, it is rendered obvious by Oh.

Oh discloses digital radio frequency transport for the reasons noted above in addressing the preamble of claim 1. Oh's disclosure of multipoint-to-point digital radio frequency transport is evidenced in FIG. 1, where reverse slave units of multiple slave units 30 receive RF signals from mobile terminals 40 via the antennas of the slave units 30.

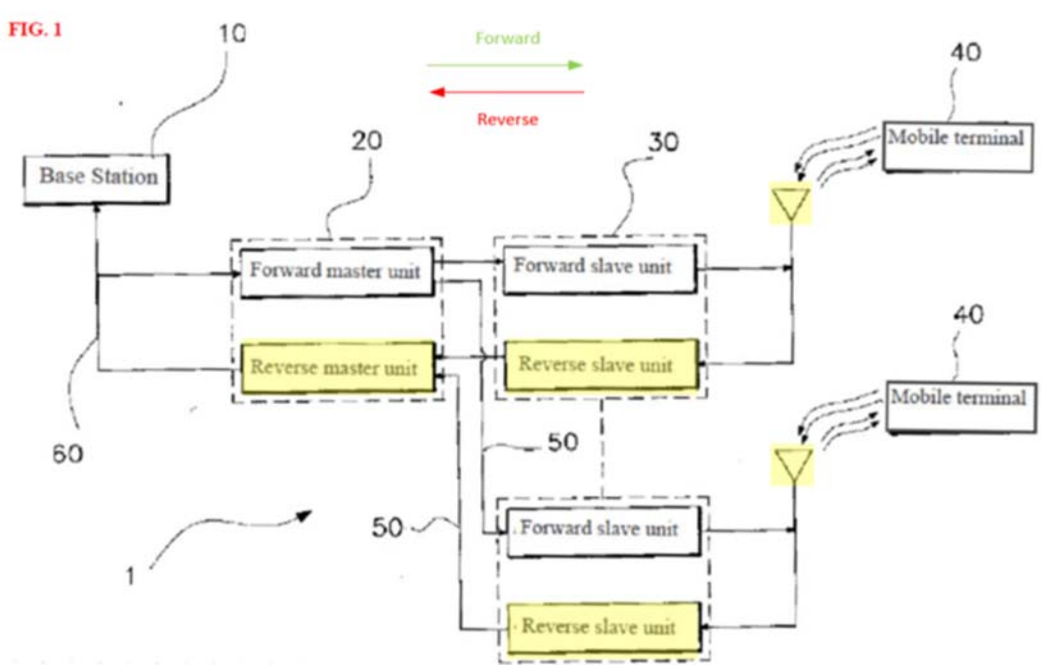


RF signals from the mobile terminals 40 are downconverted and converted to digital representations at 380. The digital signals from A/D converter unit 380 are then transmitted from the reverse slave units 300 to the reverse master unit 400 via optic lines 50. Ex. 1007, 4:26-39.

Oh therefore renders obvious each limitation recited in the preamble of claim 25 by disclosing multipoint (multiple slave units 30) to point (master unit 20) digital radio frequency (digital samples of intermediate frequency/baseband analog signals) transport (transmission of those digital signals from the multiple slave units 30 to the master unit 20 across optic lines 50). Ex. 1005, ¶¶136-138.

(b) Element 1: "receiving analog radio frequency signals at multiple digital remote units;"

Oh discloses that each reverse slave unit 300 "converts the RF signals, analog signals, transmitted from the mobile terminals 40… to the digital signals; and transmits them to the master unit 20." Ex. 1007, 4:22-25. Fig. 1 depicts multiple slave units 30 receiving analog RF signals from mobile terminals 40.

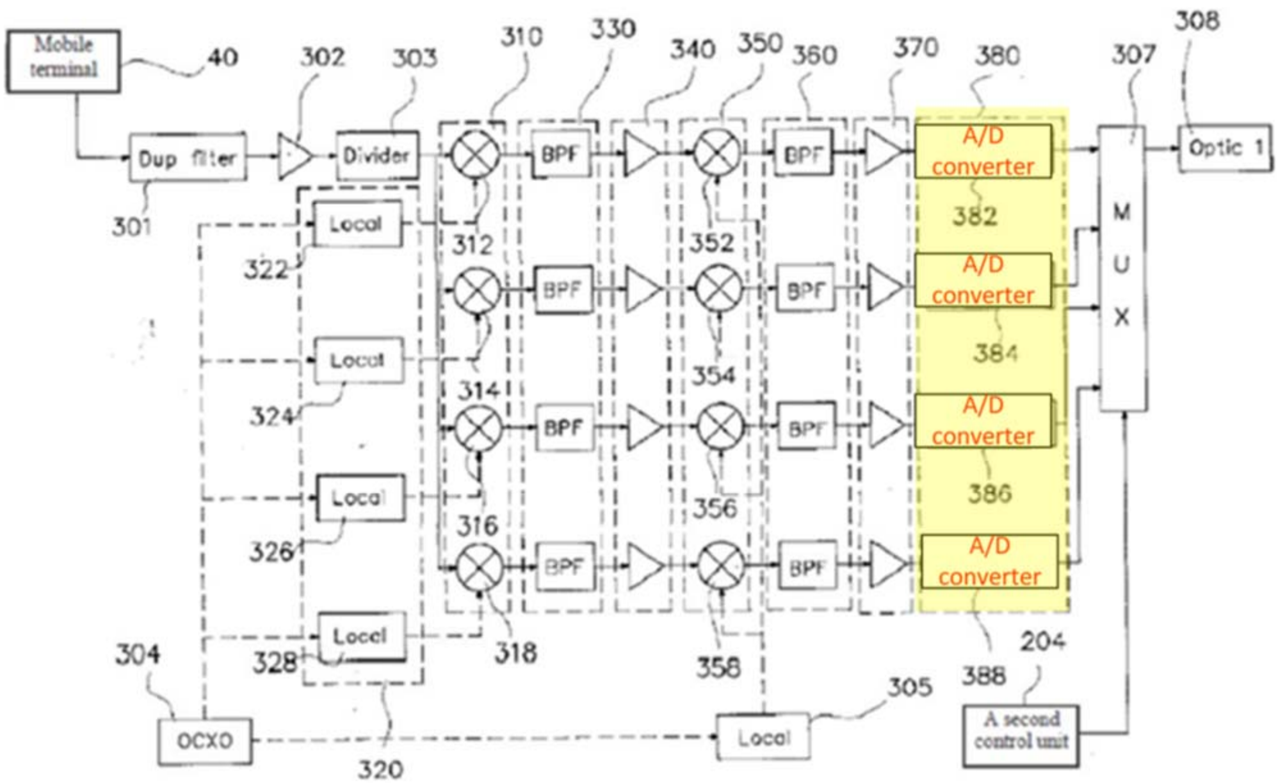


Oh discloses receiving analog radio frequency signals (RF signals from mobile terminals 40) at multiple digital remote units (multiple slave units 30). Ex. 1005, ¶¶139-140.

(c) Element 2: "converting the analog radio frequency signals to digital radio frequency signals at each of the digital remote units;"

Oh discloses that each reverse slave unit 300 "converts the RF signals, analog signals, transmitted from the mobile terminals 40 through a bi-directional filter 301, to digital signals." Ex. 1007, 4:23-25. That digitization is illustrated at Fig. 4 where "A/D converter unit 380 converts the intermediate frequency signals, analog signals, to the digital signals." *Id.*, 4:56-67.

FIG. 4



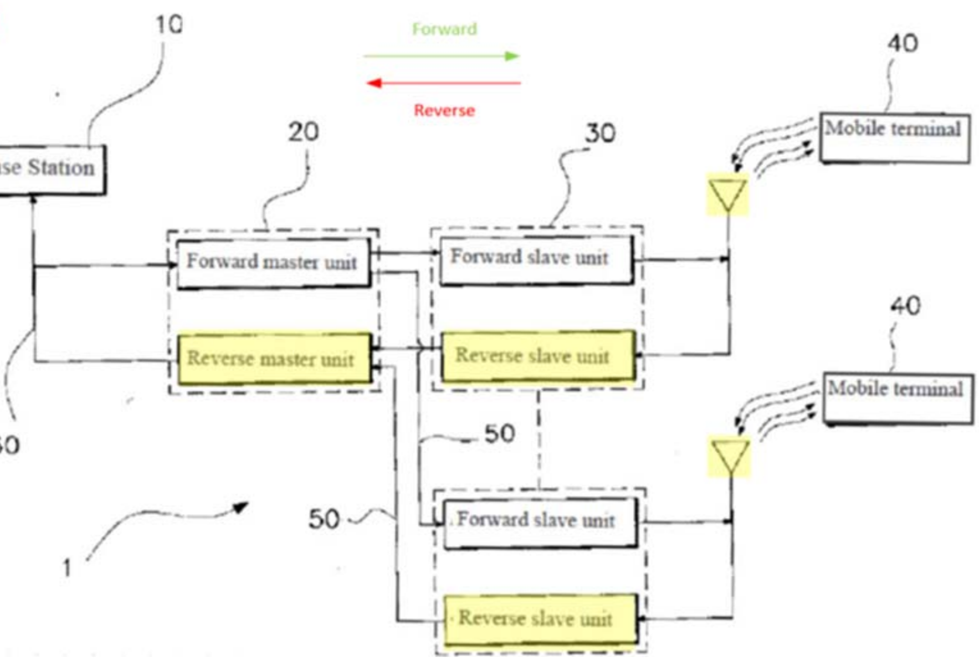
Thus, Oh discloses "converting the analog radio frequency signals (downconverted RF signals from mobile terminals 40) to digital radio frequency signals at each of the digital remote units (at A/D converters of slave units 30)." Ex.

1005, ¶¶141-142.

(d) Element 3: "optically transmitting the digital radio frequency signals from each of the digital remote units to a digital host unit;"

Oh discloses that its reverse slave units 300 multiplex "all the digital signals transmitted from said second A/D converter unit 380… to serial data signals and outputs them to the reverse master unit 400 through a third optic converter unit 308 and the optic line 50." Ex. 1007, 4:36-39.

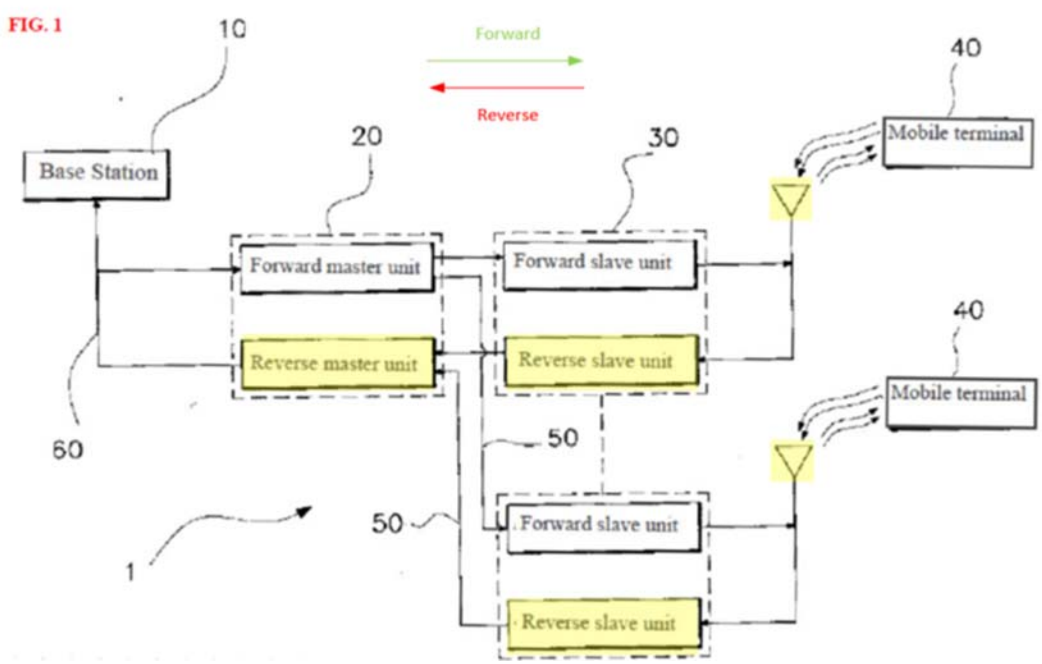
FIG. 1



Oh discloses optically transmitting the digital radio frequency signals (using optic converter unit 308) from each of the digital remote units (slave units 30) to a digital host unit (master unit 20). Ex. 1005, ¶¶143-144.

(e) Element 4: "receiving the multiple digital radio frequency signals at the digital host unit;"

Oh discloses reverse master unit 400 comprises: (i) a first demultiplexer unit 420, formed of demultiplexers connected to the optic line 50 and a fourth optic converter unit 410, respectively, that [de]multiplexes the serial data signals transmitted from each slave unit 30, separates them into four different frequency bands applicable to the allocated frequency bandwidths and the NMS signals, and outputs to five output ports, respectively. Ex. 1007, 4:65-68.



Oh discloses receiving the multiple digital radio frequency signals (the digital samples from the A/D converters at slave units 30) at the digital host unit (master unit 20). Ex. 1005, ¶¶145-146.

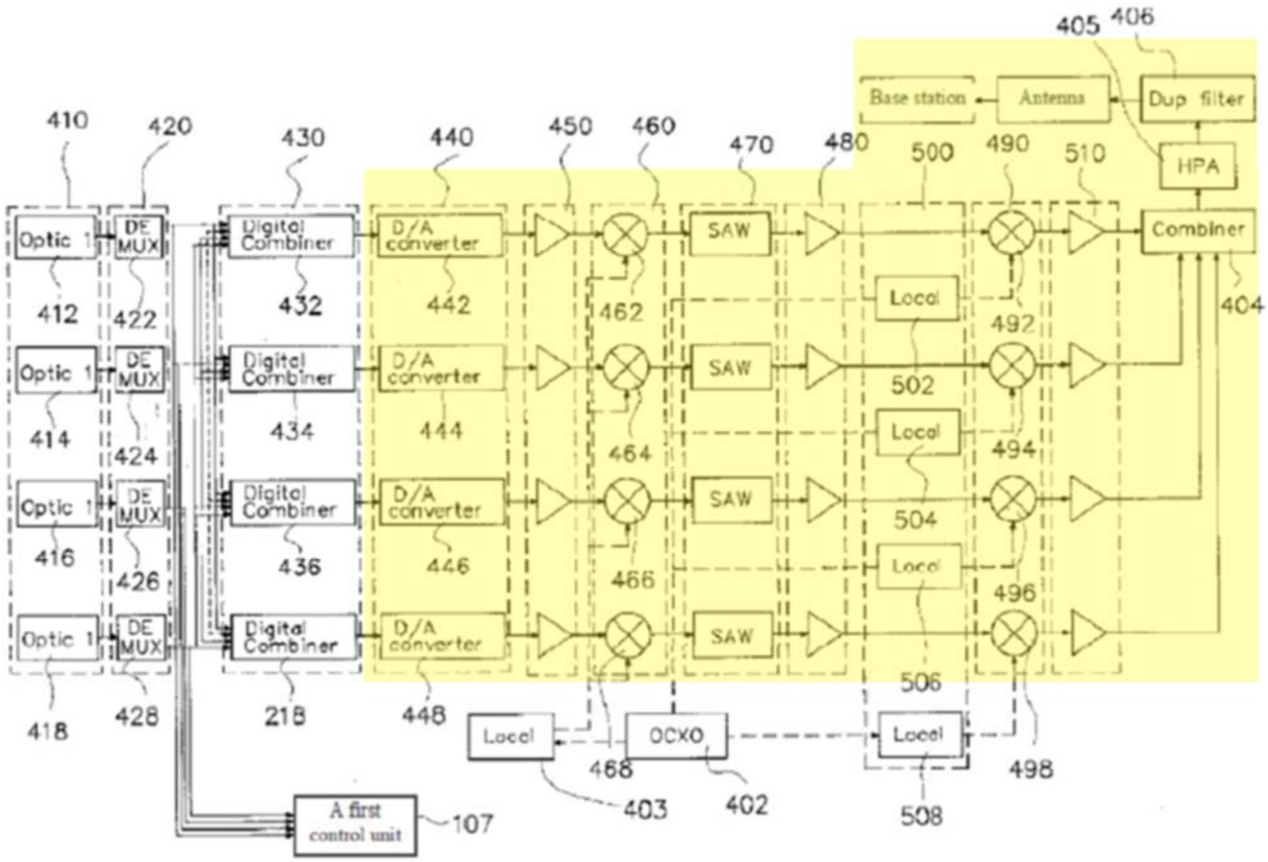
(f) Element 5: "digitally summing the multiple digital radio frequency signals together;"

Oh discloses Element 5 for the reasons discussed above for Claim 1, Element 3. Ex. 1005, ¶147.

(g) Element 6: "converting the summed multiple digital radio frequency signals back to analog radio frequency signals and transmitting the signals to a wireless interface device for further transmission to a switched telephone network."

Following the digital summing operation of Element 5, the summed digital data values are converted to analog signals, up converted to the appropriate frequency signals associated with their particular bands to create component analog signals, that are then combined (*i.e.*, analog combining) and transmitted to a base station via an antenna. Ex. 1005, ¶58. As discussed above, Oh, as evidenced by Fig. 5's depiction of master unit 20 communicating with base station 10 via an antenna, evidences the obviousness of wireless communications between a base station and master unit.

FIG. 5



Specifically Oh states:

After creating 14-bit intermediate frequency signals by combining four 12-bit intermediate frequency signals in the same frequency band, said digital combiner transmits them to a first D/A converter unit 440. Each D/A converter … transmits 1.23MHz or 1.5MHz intermediate frequency signals to… a third mixer unit 460 through a third amplification unit 450… The intermediate frequency signals outputted from said third mixer unit 460 are transmitted to a fourth mixer unit 490 through a first saw filter unit 470 and a fourth amplification unit 480. Said fourth mixer unit 490 mixes the oscillating frequency in different frequency bands… and transmits 800MHz RF signals in different frequency bands to a first combiner 404 through a fifth amplification unit 510.

Ex. 1007, 5:16-26. The analog signals are combined (*i.e.*, analog combining) at 404 to "aggregate the RF signals in different frequency bands transmitted from four mixers 492, 494, 496, and 498," and are amplified at 510 and run through a bi-directional filter 406 to an antenna and a base station.[3] Ex. 1005, ¶58. The Patent Owner admits that a POSITA would understand a base station to include conventional base station hardware includes radio controller or interface circuitry 322 to an MTSO or telephone switched network. Ex. 1001, 6:24-27. Further, Wala (Ex. 1009) evidences that it was well known in the art for RF transport systems to communicate with switched telephone networks (*e.g.*, via base stations). *See*, Ex. 1009, Fig. 1, 588 ("Because the voice channels between the mobile telephone switching office (MTSO) and the cell site are often already in digitized form…").

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[3] Recall that '982 states that a wireless interface device may comprise a base station.

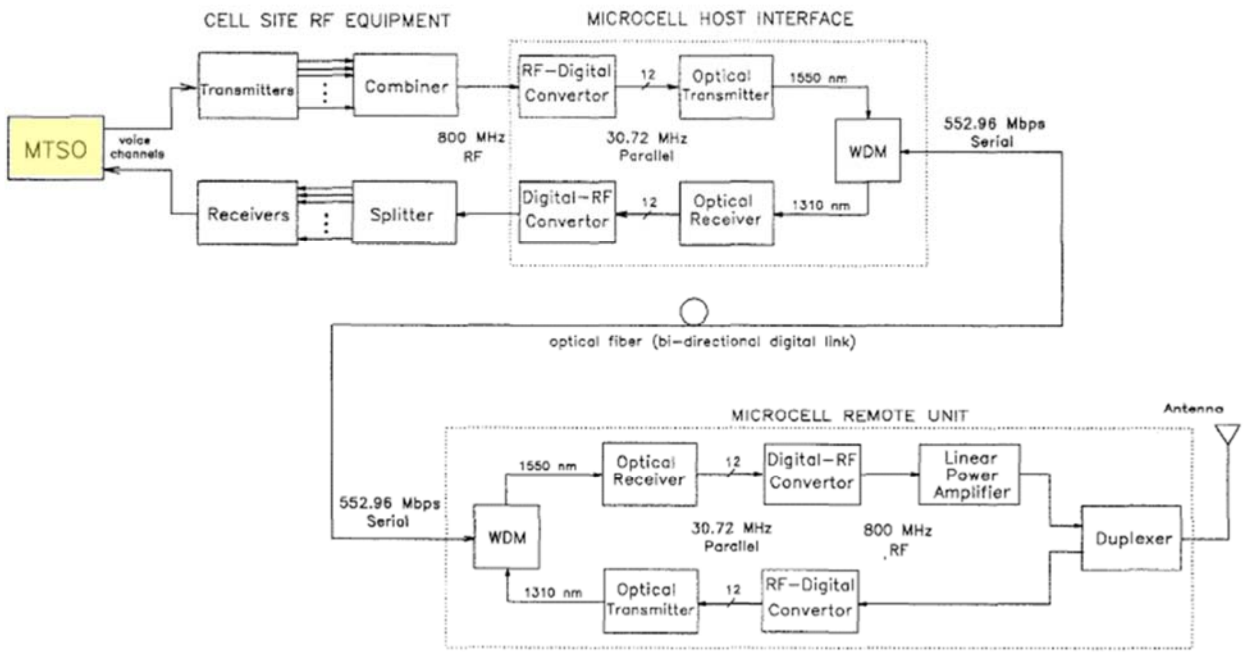


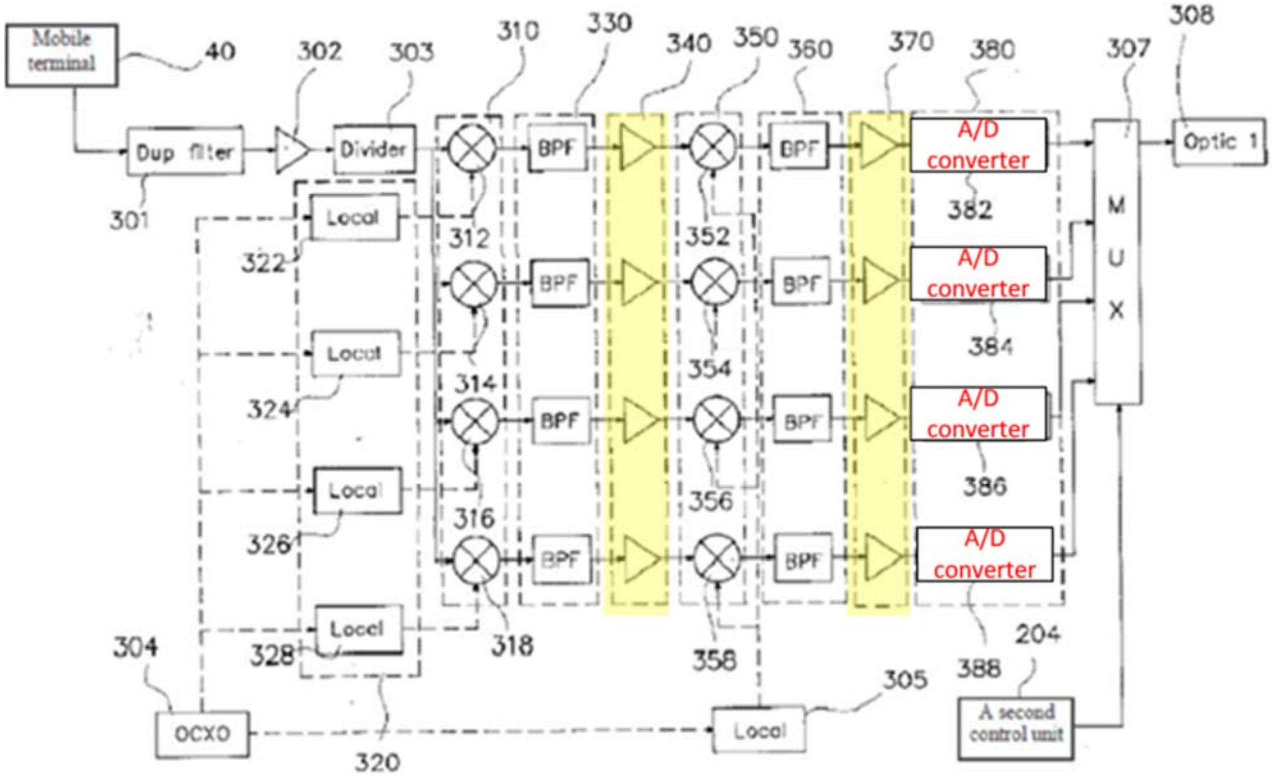
Fig.1. Digital RF transport microcell: system block diagram

Oh discloses converting the summed multiple digital radio frequency signals (outputs of 430) back to analog radio frequency signals (at 440) and transmitting the signals (signals analog combined at 404) to a wireless interface device (405, 406, antenna, base station) for further transmission to a switched telephone network (to which a POSITA would understand the base station to be connected by conventional means). Ex. 1005, ¶¶148-149; 58.

12. Dependent Claim 26

In Oh, prior to digitizing the analog radio frequency signals at 380, those signals are passed through amplification units 340 and 370.

FIG. 4



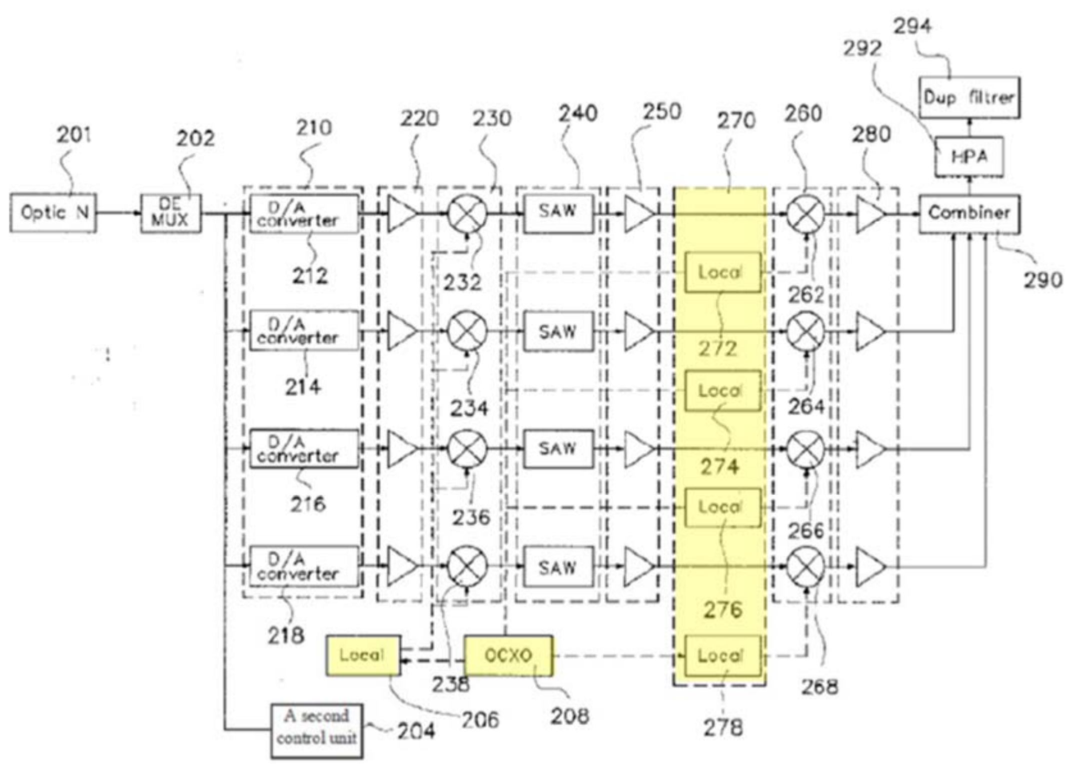
Oh renders obvious converting the analog radio frequency signals to digital radio frequency signals comprises amplifying the analog radio frequency signals (amplification at 340, 370 prior to conversion to digital at 380). Ex. 1005, ¶¶150-151.

13. Dependent Claim 27

The '982 patent notes that reference oscillators in its units (*e.g.,* digital host unit 420 and digital remote units 540) operate as "master clocks" for forward and reverse signal processing, where a "local oscillator is locked to the reference oscillator… as a master clock so that the down conversion of the RF signals is the same as the up conversion. The result is[,] end to end, from DHU to DRU, or DHU to one or more DEUs to DRU, no frequency shift in the signals received and transmitted." Ex. 1001, 7:25-20. Similar to the limitation of claim 9 above, which referenced synchronizing forward and reverse oscillators in a host unit, claim 27 describes such synchronization in remote units.

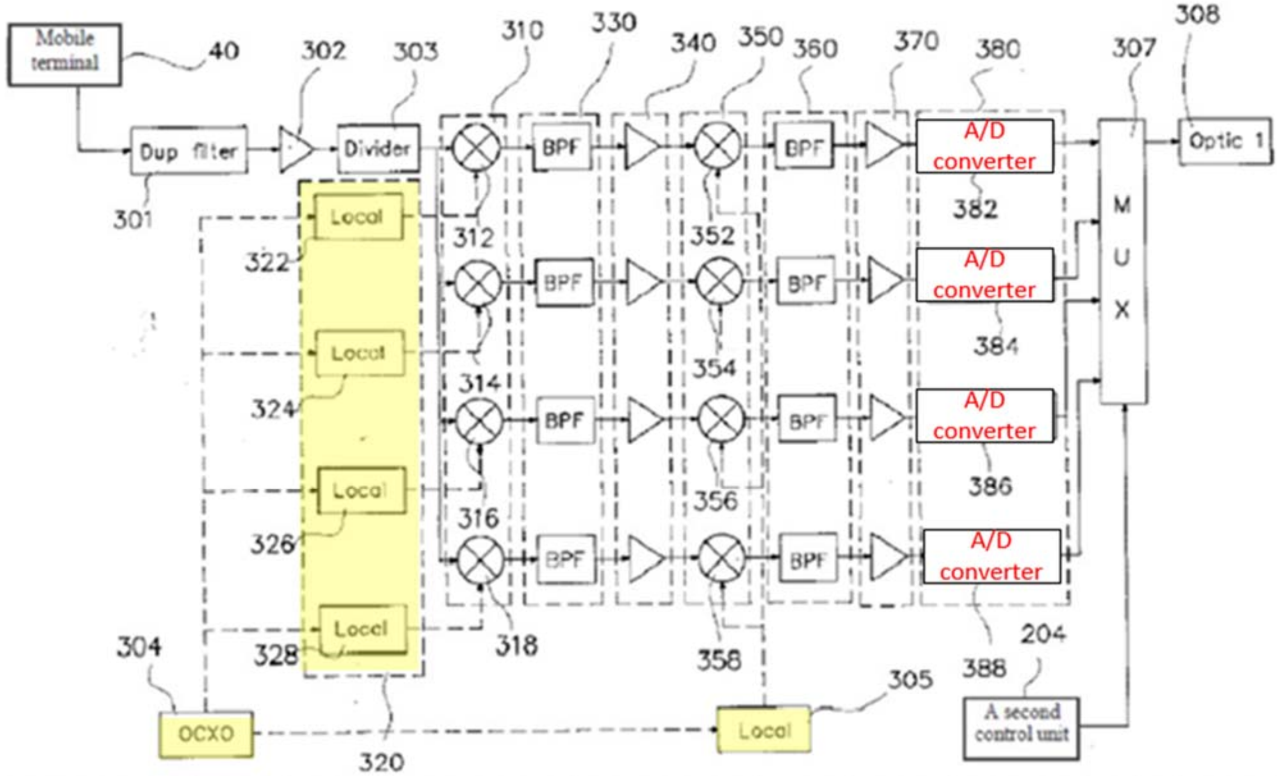
Oh discloses that slave units 30 include local oscillators 206 (for converting from near DC to 70 MHz: Ex. 1007, 3:54-56), 272, 274, 276, 278 (for converting from 70 to 801.23, 803.69, 806.15, 808.61 Mhz: Ex. 1007, 4:6-9) coupled to oven-controlled reference oscillator 208 in the forward direction of Fig. 3.

FIG. 3



And Oh discloses that slave units 30 include local oscillators 322, 324, 326, 328 (for converting from 801.23, 803.69, 806.15, 808.61 to 70Mhz: Ex. 1007, 4:43-47), and 305 (for converting from 70MHz to near DC: Ex. 1007, 4:48-53) coupled to oven-controlled reference oscillator 304 in the reverse direction of Fig. 4.

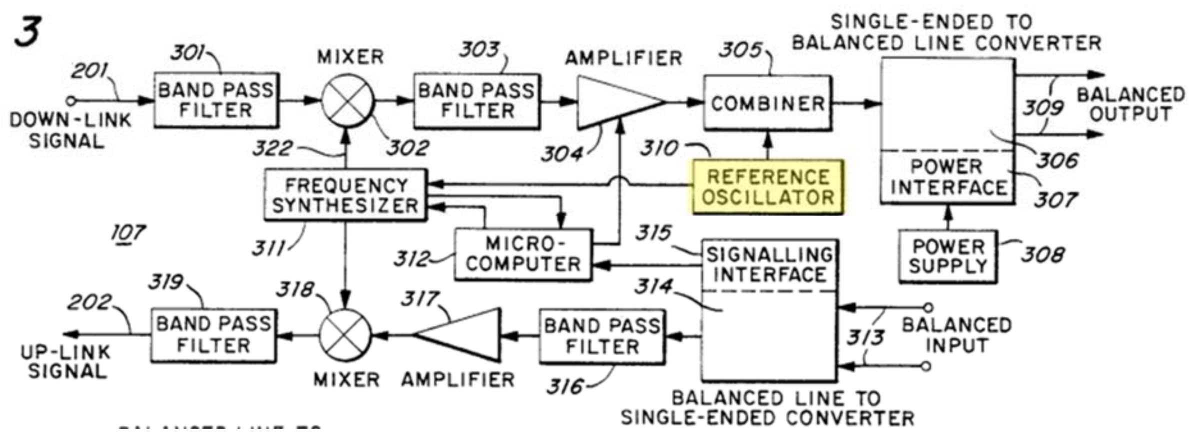
FIG. 4



Oh's disclosure of oven controlled reference oscillator (208 in Fig. 3, 304 in Fig. 4) in remote slave unit 30 teaches the limitation. To the extent that Oh is not explicit that reference 208 in Fig. 3 and 304 in Fig. 4 are indicating the same reference oscillator, such an implementation would be obvious to a POSITA. Because the forward and reverse frequency translations are to the same frequencies (*i.e.* 70MHz to/from about 800MHz; near DC to/from 70MHz), the local oscillators operating in Figs. 3 and 4 will be operating at about the same frequencies. Having those common local frequencies being generated in Figs. 2 and 5 using a single, common oven-controlled reference oscillator would have been an obvious design choice because using a single reference oscillator would have reduced part count, reduced power consumption, and reduced reliability concerns caused by additional parts that would be present if separate oven controlled reference oscillators were used. As illustrated in Figs. 2 and 5 already, a single reference oscillator is used to generate several local oscillator frequency signals. Thus implementing master unit 20 with a single reference oscillator 106/402 would have been obvious.

And as discussed above with reference to claim 9, forward and reverse synchronization was well known and obvious, as evidenced by van der Kaay (Ex. 1019), which a POSITA would have been motivated to combine with Oh for the reasons discussed above with reference to claim 9.

FIG. 3



Oh renders obvious converting the analog radio frequency signals to digital radio frequency signals (in slave unit 30) comprises synchronizing a reverse path local oscillator (one of 305, 322, 324, 326, 328) to a master clock (208, 304, a single oscillator operating in slave unit 30's forward and reverse paths) so as to reduce end-to-end frequency translation (*e.g.*, as described with reference to oscillators 415, 468 in Ex.

1001, 7:22-30). Ex. 1005, ¶¶152-156.

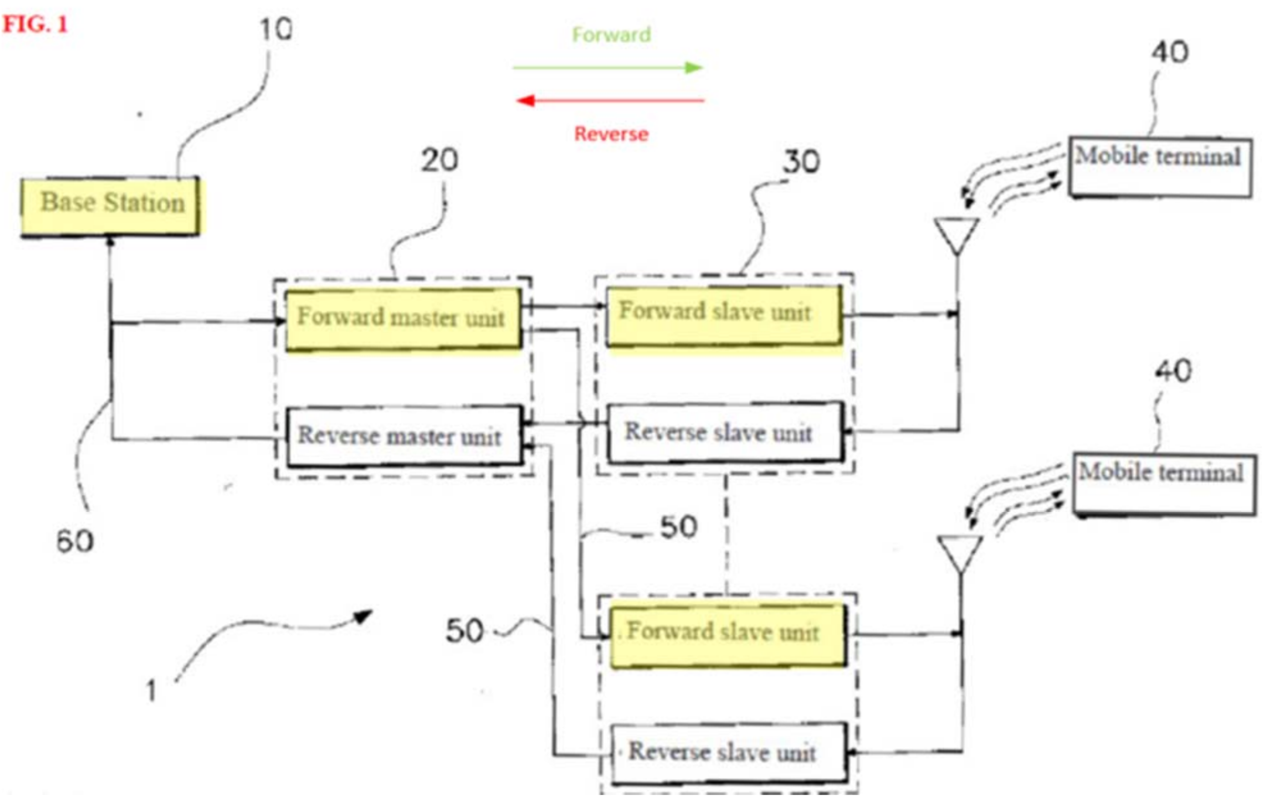
14. Independent Claim 28

(a) Preamble

To the extent the preamble of claim 28 is limiting, it is rendered obvious by Oh.

Oh discloses digital radio frequency transport for the reasons noted above in addressing the preamble of claim 1. Oh's disclosure of point-to-multipoint digital radio frequency transport is evidenced in FIG. 1, where the master unit 20 receives RF signals from base station 10.

FIG. 1



RF signals from base station 10 are downconverted and converted to digital representations at 380. The digital signals from A/D converter unit 180 are then transmitted from the forward master unit forward slave units of multiple slave units 30 via optic lines 50. Ex. 1007, 3:38-44.

Oh therefore renders obvious each limitation recited in the preamble of claim 28 by disclosing point (master unit 20) to multipoint (multiple slave units 30) digital radio frequency (digital samples of intermediate frequency/baseband analog signals from the base station 10) transport (transmission of those digital signals from the master unit 20 to the slave units 30 across optic lines 50). Ex. 1005, ¶¶157-159.

(b) Element 1: "receiving radio frequency signals at a digital host unit;"

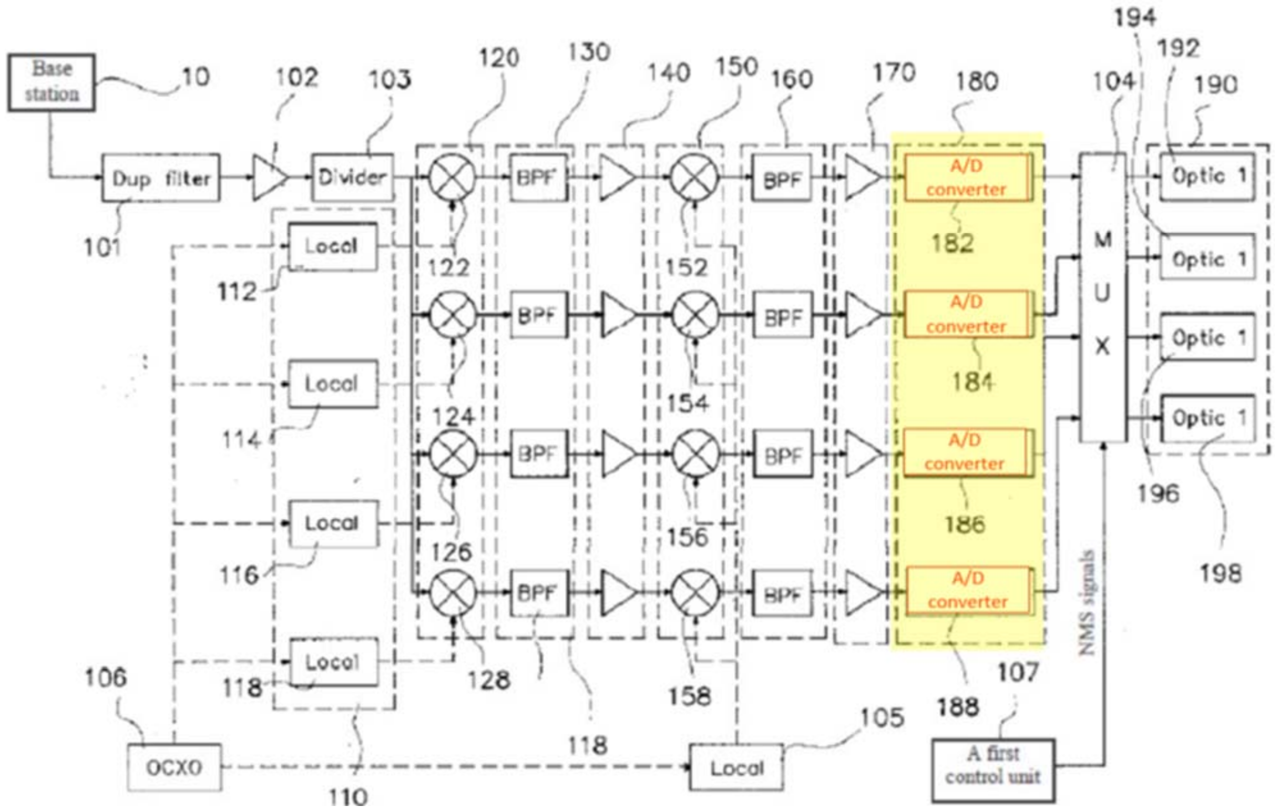
Oh states that the forward master unit 100 of the master unit 20 "executes a first means that converts RF signals, analog signals, transmitted from the base station 10 to the intermediate frequency signals; converts them to digital signals; and transmits them to the slave unit 30 through the optic line 50." Ex. 1007, 3:4-6.

Oh renders obvious receiving radio frequency signals (RF signals from base station 10) at a digital host unit (master unit 20). Ex. 1005, ¶160.

(c) Element 2: "converting, using a shared analog-to-digital converter, the radio frequency signals to a digitized radio frequency spectrum;"

Following receipt from base station 10, Oh's forward master unit divides the received analog RF signal at 103 into its component frequency bands, downconverts those frequency band signals to near DC at 120-270, and digitizes those component band signals at A/D converter unit 180. Ex. 1007, 3:6-18.

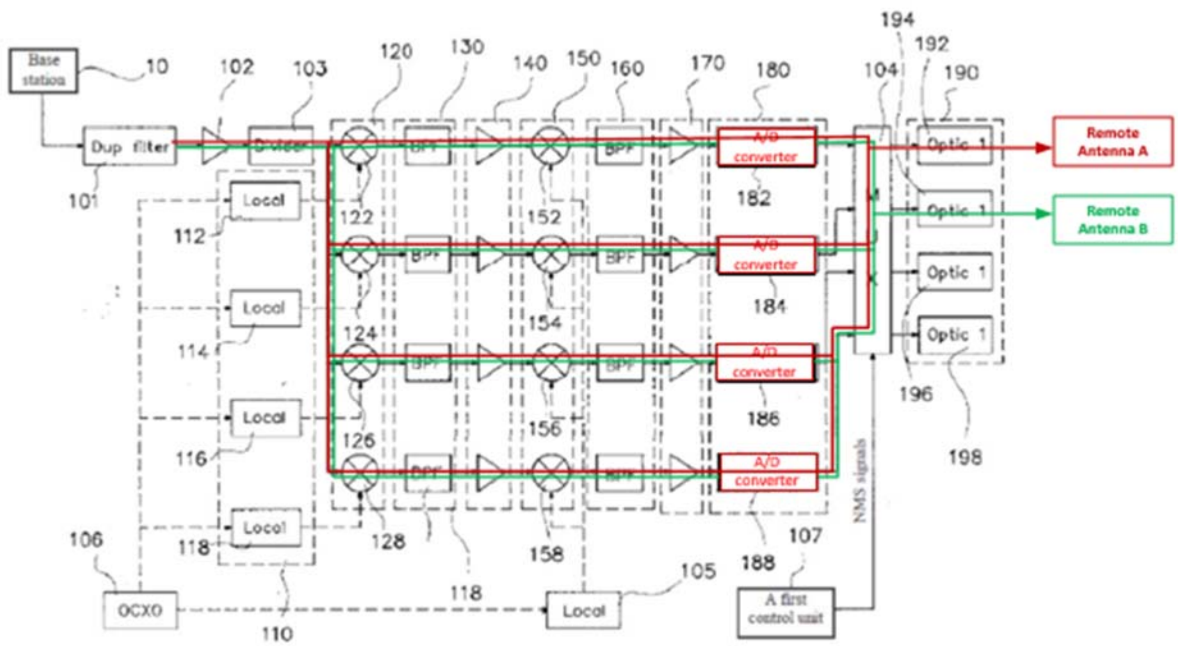
FIG. 2



As discussed above, the '982 does not use the term "shared circuitry" beyond paraphrases of the claim language. But in a prior litigation, Patent Owner has clarified that "'shared circuitry' was intended to mean circuitry that is used to support more than one remote unit." Ex. 1008, ¶316. There it identified '982 patent's "circuitry in box 491, the mux 465, and fan out buffer 431" as support for downstream shared circuitry in the specification.

Oh discloses an analogous components. On the downstream path of Fig. 2, Oh's circuitry at 120, 130, 140, 150, 160, 170, 180 down converts the analog signals received from the base station to near DC and samples that data, just like the '982 patent's "circuitry in box 491." Oh similarly includes a multiplexer 104 that serializes the digitized data and distributes it to the remote slave units 30.

FIG. 2

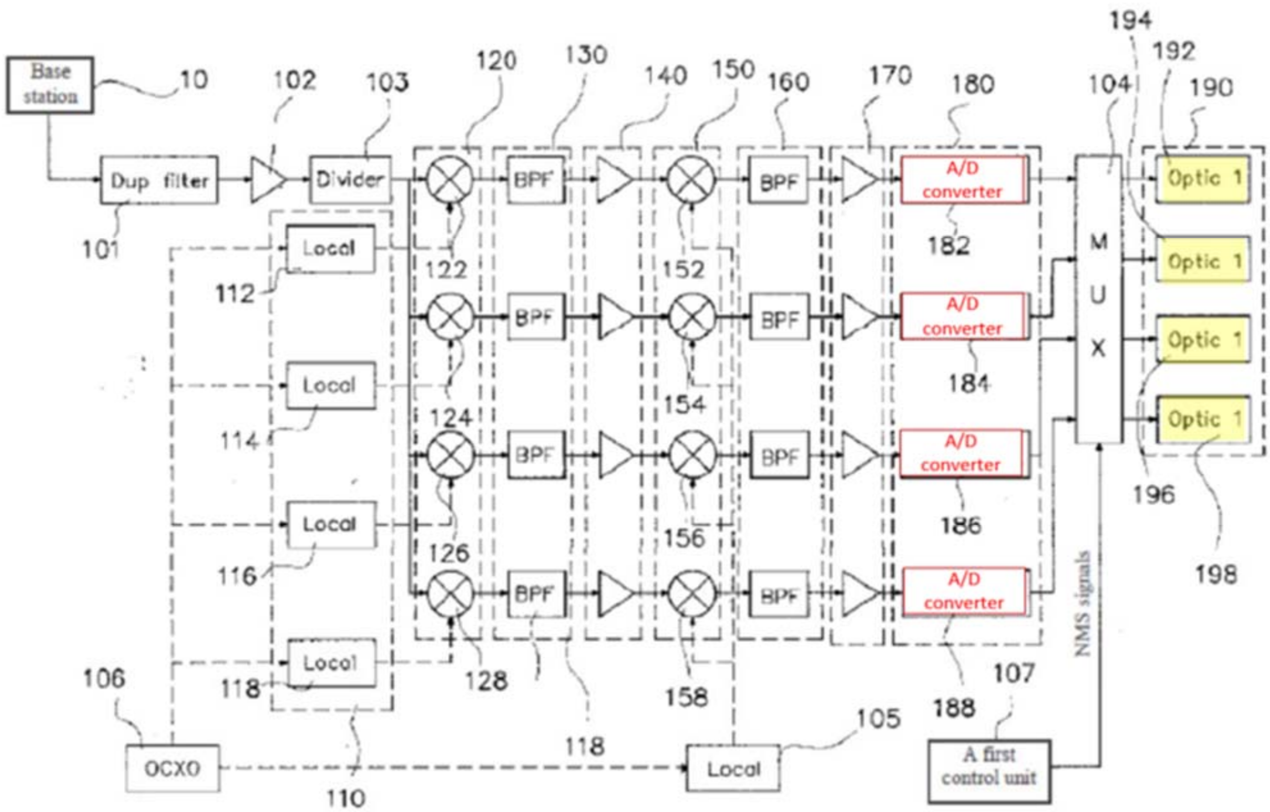


By disclosing one A/D converter unit 180 that digitizes the component analog signals for transmission of digital samples to multiple remote units, Oh renders obvious converting, using a shared analog-to-digital converter (A/D converter unit 180 that services multiple slave units 30 via optic lines 192, 194, 196, 198), the radio frequency signals to a digitized radio frequency spectrum. Ex. 1005, ¶¶161-164.

(d) Element 3: "optically transmitting the digitized radio frequency spectrum output by the shared analog-to-digital converter to a plurality of digital remote units;"

Oh discloses "a first MUX 104 that [multiplexes] all digital signals transmitted from said first A/D converter unit 180 with the NMS signals transmitted from a first control unit 107 and outputs the serial data signals to the forward slave unit 200 of the slave unit 30 through a first optic converter unit 190 and the optic line 50." Ex. 1007, 3:16-18; 38-46.

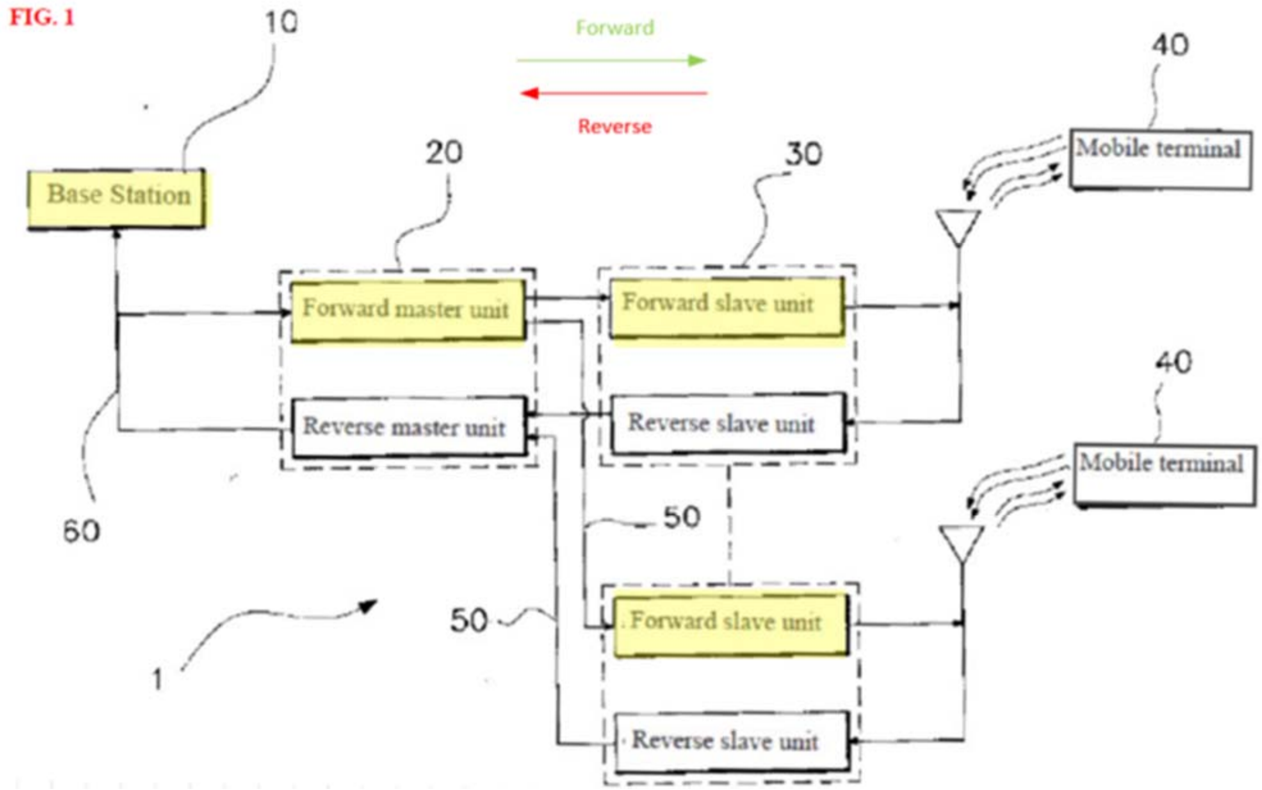
FIG. 2



Oh thus renders obvious optically transmitting (using optic converters 192, 194, 196, 198) the digitized radio frequency spectrum output by the shared analog-to-digital converter (A/D converter 180) to a plurality of digital remote units (slave units 30). Ex. 1005, ¶¶165-166.

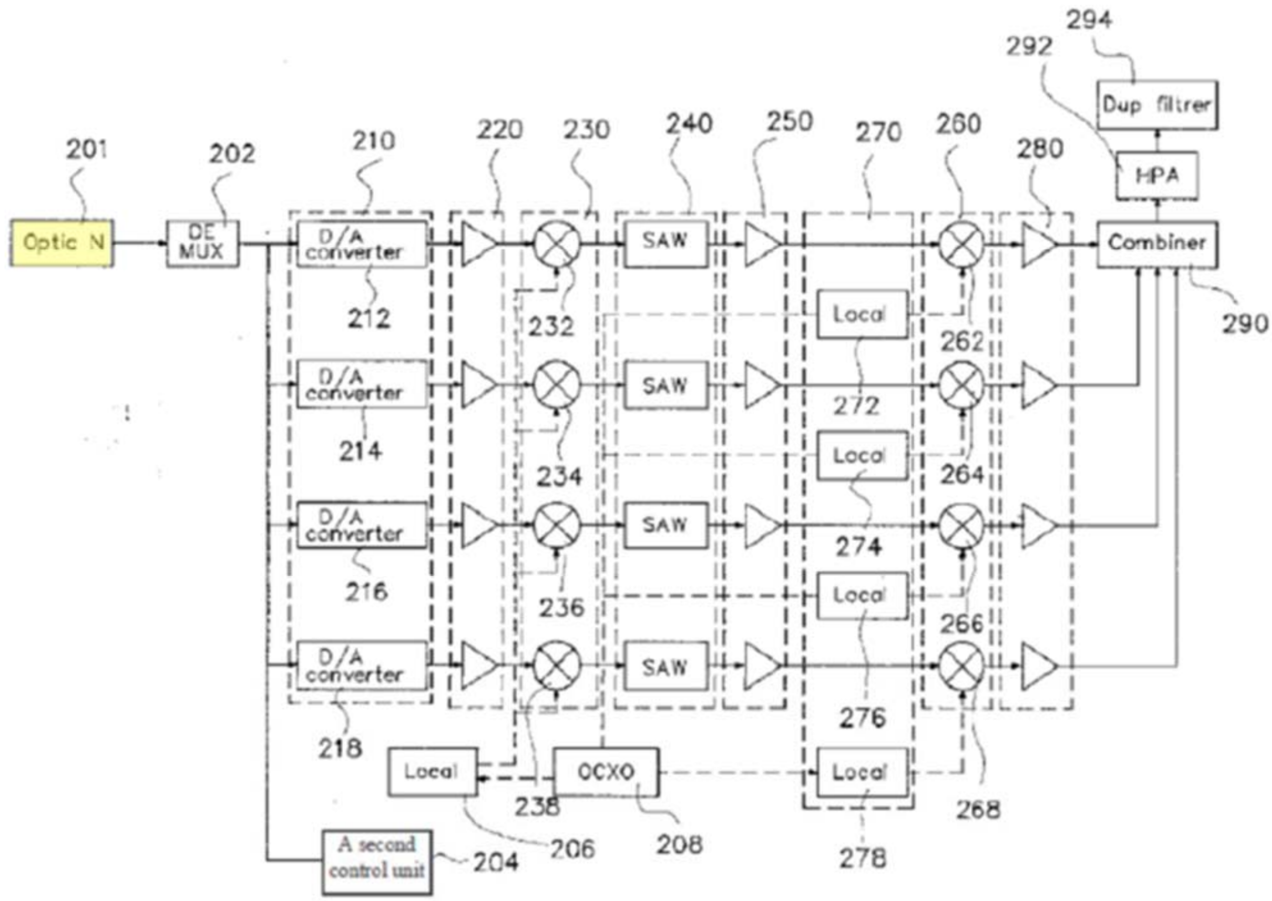
(e) Element 4: "receiving the digitized radio frequency spectrum at the plurality of digital remote units;"

Oh discloses that the optic converter unit 190 transmits digitized radio frequency spectrum data to multiple slave units over optic line 50 as depicted in FIG. 1. Ex. 1007, 3:16-18; 38-44.



The forward slave unit 200 of the slave unit 30 "converts the digital signals transmitted from the master unit 20 through the optic line 50 to the intermediate frequency signals, analog signals; converts them to the RF signals and transmits them to the mobile terminals 40." Ex. 1007, 3:47-49.

FIG. 3

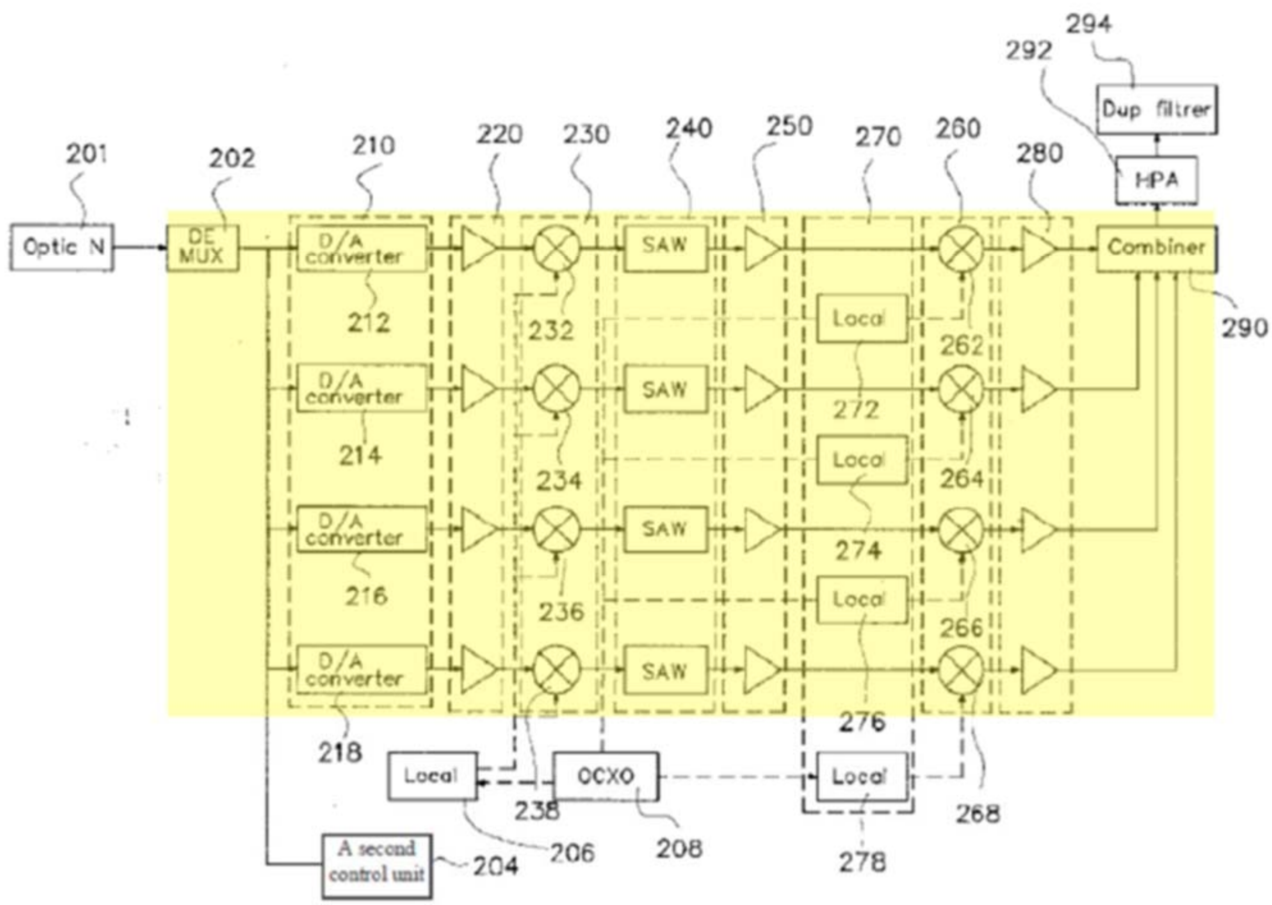


Oh thus renders obvious receiving the digitized radio frequency spectrum (digital samples from master unit 20) at the plurality of digital remote units (slave units 30 at 201). Ex. 1005, ¶¶167-169.

(f) Element 5: "converting the digitized radio frequency spectrum to analog radio frequency signals;"

Oh discloses that the forward slave unit 200 of the slave unit 30 "converts the digital signals transmitted from the master unit 20 through the optic line 50 to the intermediate frequency signals, analog signals; converts them to the RF signals and transmits them to the mobile terminals 40." Ex. 1007, 3:47-49. That process is described in further detail at 3:50-61, where the digital samples from the master unit 20 are routed for recreation of the component analog band signals and upconverted to component analog radio frequency signals which are combined at 290 (*i.e.*, analog combining) prior to transmission to mobile terminals 40. Ex. 1005, ¶58.

FIG. 3

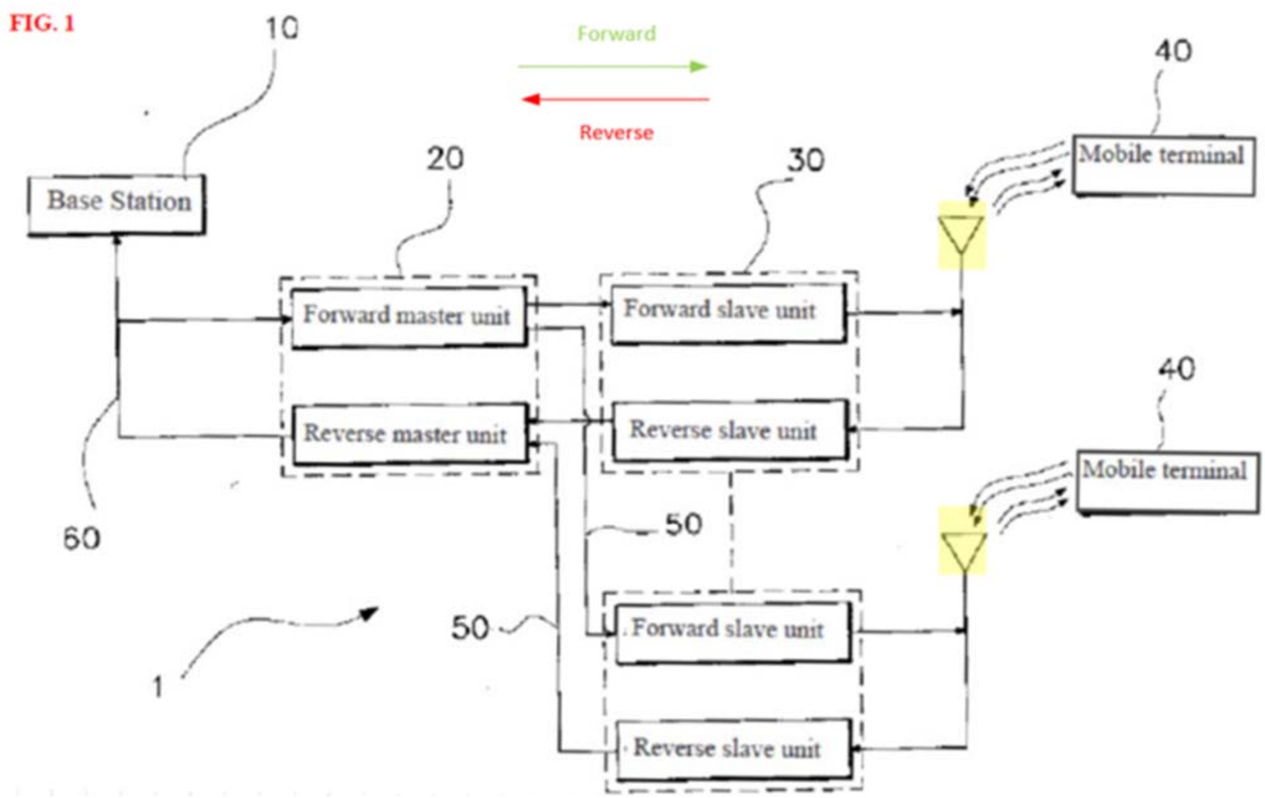


Oh renders obvious converting the digitized radio frequency spectrum (digital sample data received from master unit 20 at 201) to analog radio frequency signals (converting from digital to analog signals, upconverting the analog signals to their respective band frequencies, and analog combining to form analog radio frequency signals for transmission to mobile terminals 40). Ex. 1005, ¶¶170-171, 58.

(g) Element 6: "transmitting the analog radio frequency signals via a main radio frequency antenna at each of the plurality of digital remote units."

Oh discloses that the digital signals from the master unit 20 are converted to analog, upconverted to RF, and transmitted to the mobile terminals 40. Ex. 1007, 3:47-49. Fig. 1 of Oh depicts the main frequency antenna associated with each slave unit 30 for bidirectional communications with the mobile terminals 40.

FIG. 1

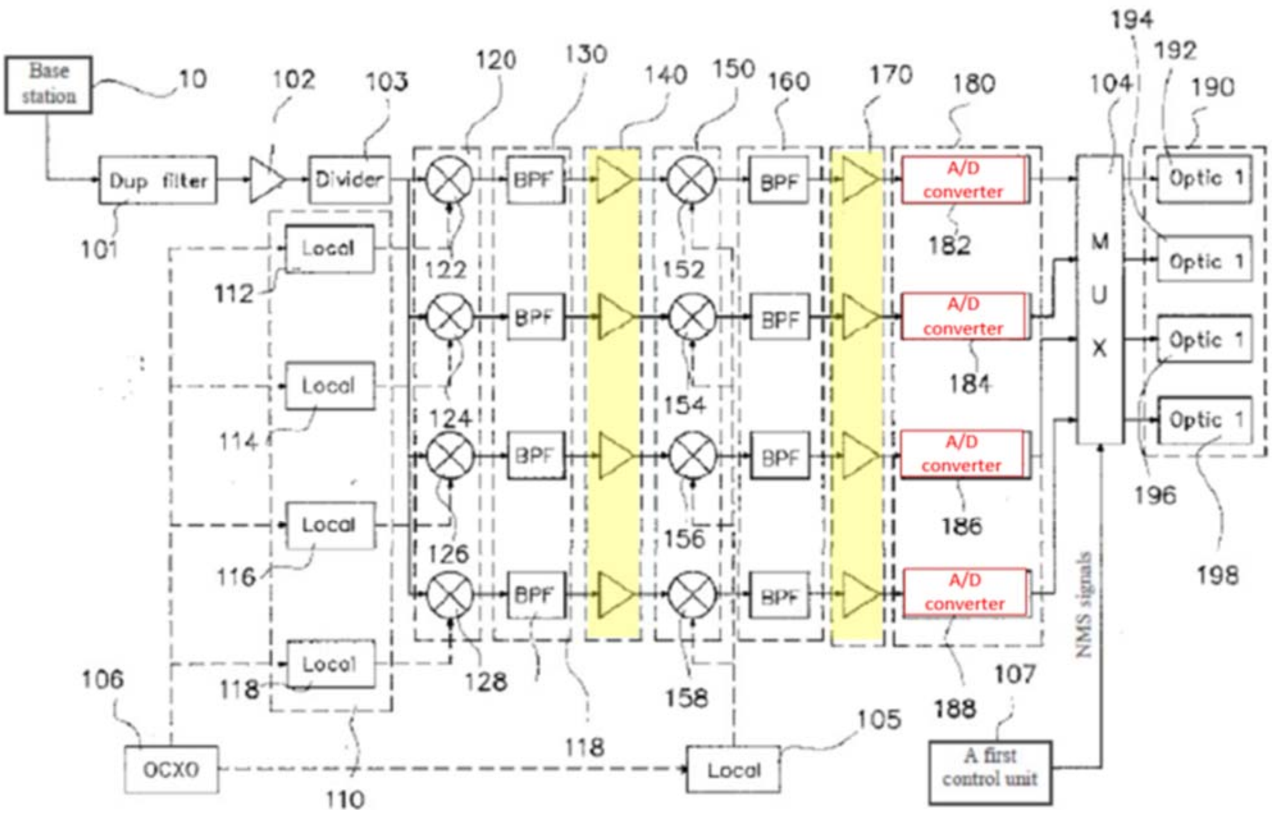


Oh renders obvious transmitting the analog radio frequency signals (analog combined signals from combiner 290) via a main radio frequency antenna at each of the plurality of digital remote units (slave units 30). Ex. 1005, ¶¶172-173.

15. Dependent Claim 29

In Oh, prior to digitizing the analog radio frequency signals at 180, those signals are passed through amplification units 140 and 170.

FIG. 2

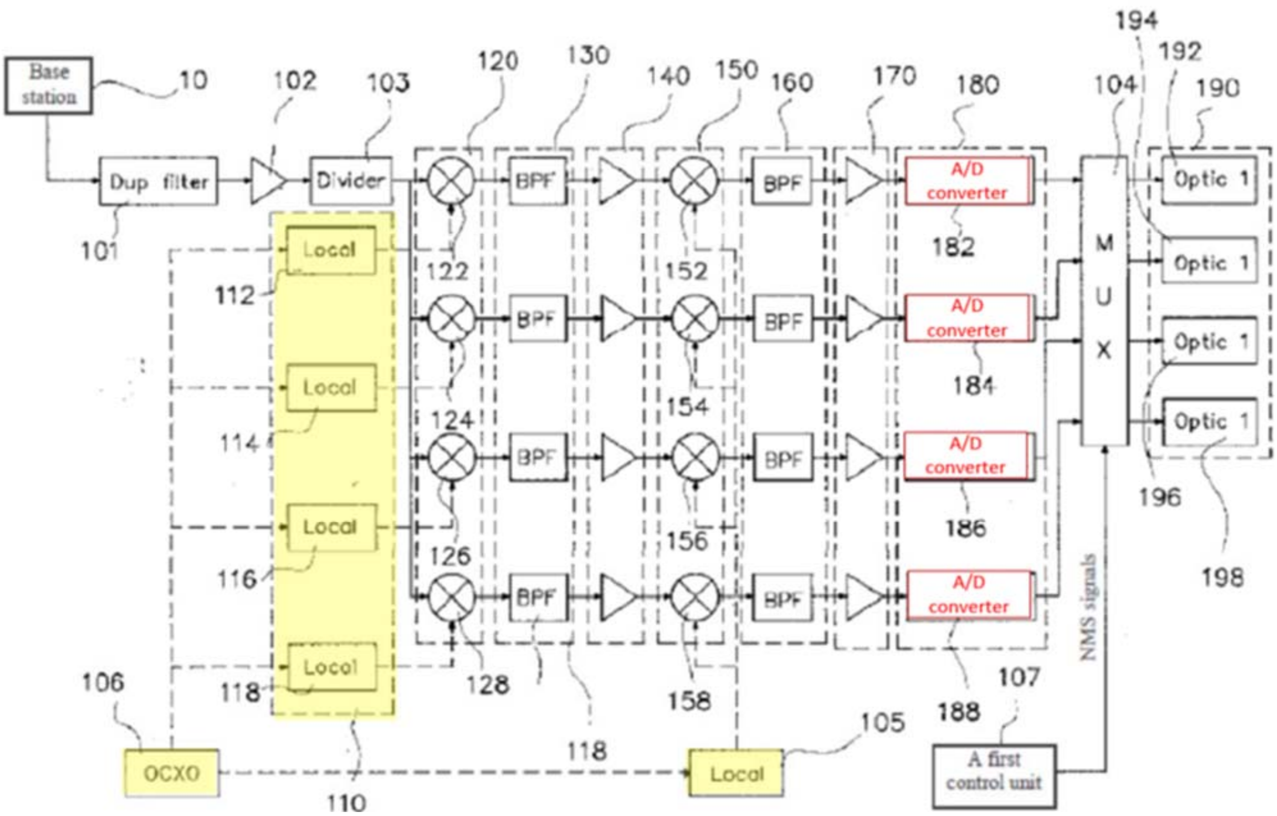


Oh renders obvious converting the radio frequency signals to a digitized radio frequency spectrum comprises amplifying the radio frequency signals (amplification at 140, 170 prior to conversion to digital at 180). Ex. 1005, ¶¶174-175.

16. Dependent Claim 30

Oh discloses the process of downconverting the component band analog signals prior to digitization, mixing operations are performed at 120 and 150 to bring the band components close to DC. Ex. 1007, 3:6-14. Those mixing operations using signals from forward path oscillators 112, 114, 116, 118 from first local oscillator unit 110 and second local oscillator unit 105. The local oscillators are synchronized with the reference oven controlled crystal oscillator (OCXO). "Said first local unit 110 and second local unit 105 convert the oscillating frequencies transmitted from the oscillator 106 and transmits the oscillating frequency to each mixer of a first mixer unit 120 and a second mixer unit 150." *Id.*, 3:45-46.

FIG. 2



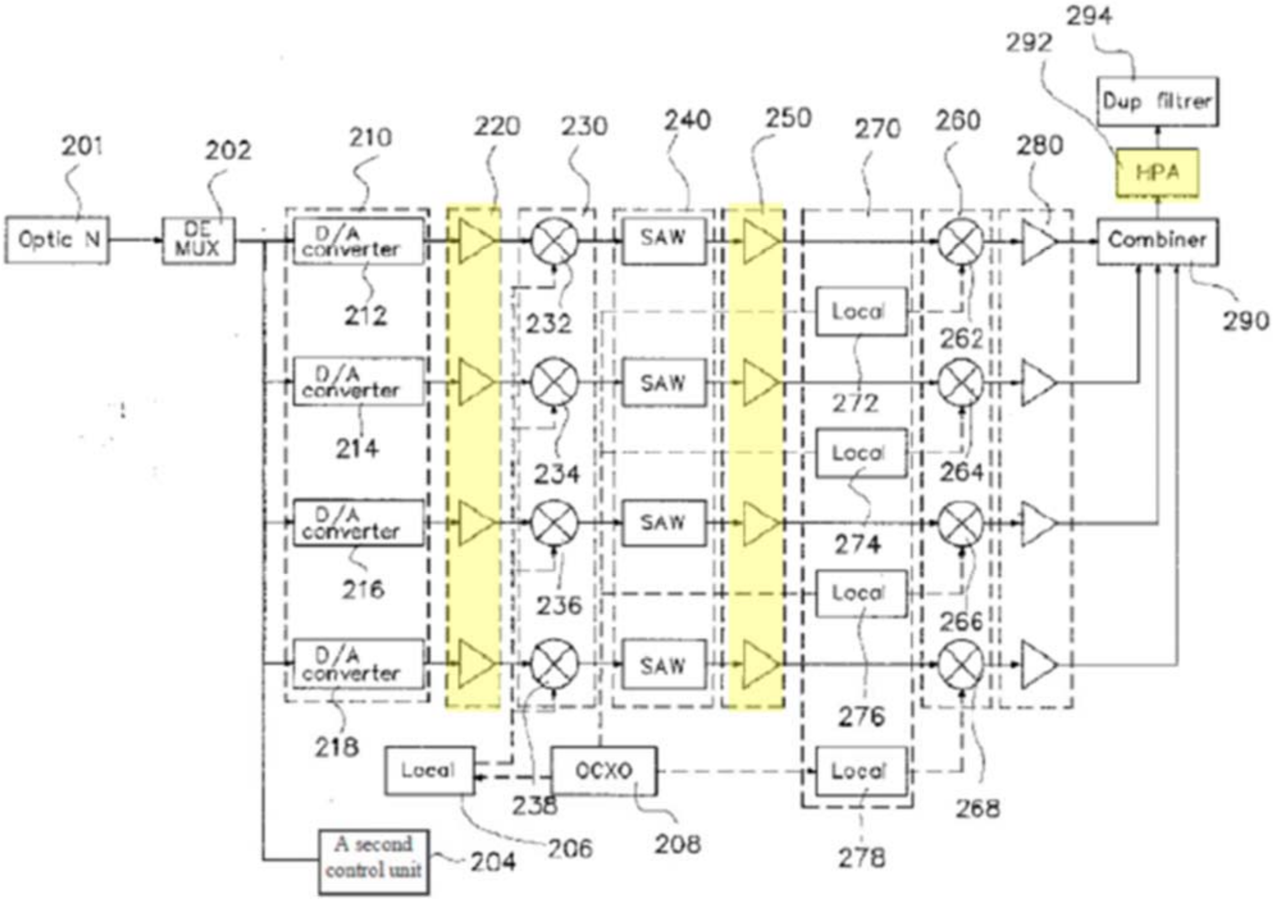
As noted above in addressing claim 27, the '982 patent states that frequency shifts are minimized when a common reference oscillator is used "as a master clock so that the down conversion of the RF signals is the same as the up conversion." Ex. 1001, 7:25-30. As noted above in addressing claim 9, a POSITA would have considered it obvious to implement Oh's master unit 20 using a single oven controlled reference oscillator for both forward and reverse frequency conversions. Thus using a single oven controlled reference oscillator for converting the radio frequency signals to a digitized radio frequency spectrum reduces end-to-end frequency translation.

Oh renders obvious converting the radio frequency signals to a digitized radio frequency spectrum digital radio frequency signals (at 180) comprises synchronizing a forward path local oscillator (local oscillators 112, 114, 116, 118, 105) to a reference oscillator (106) so as to reduce end-to-end frequency translation. Ex. 1005, ¶¶176-178.

17. Dependent Claim 31

In Oh, after converting the digital samples from the master unit 20 to analog at 210 and prior to transmitting the analog radio frequency signals to the mobile terminals 40, those signals are passed through amplification units 220 and 250 during their band component upconversion, and then the analog combined signal from 290 is further amplified by high power amplifier 292. Ex. 1007, 3:50-61.

FIG. 3

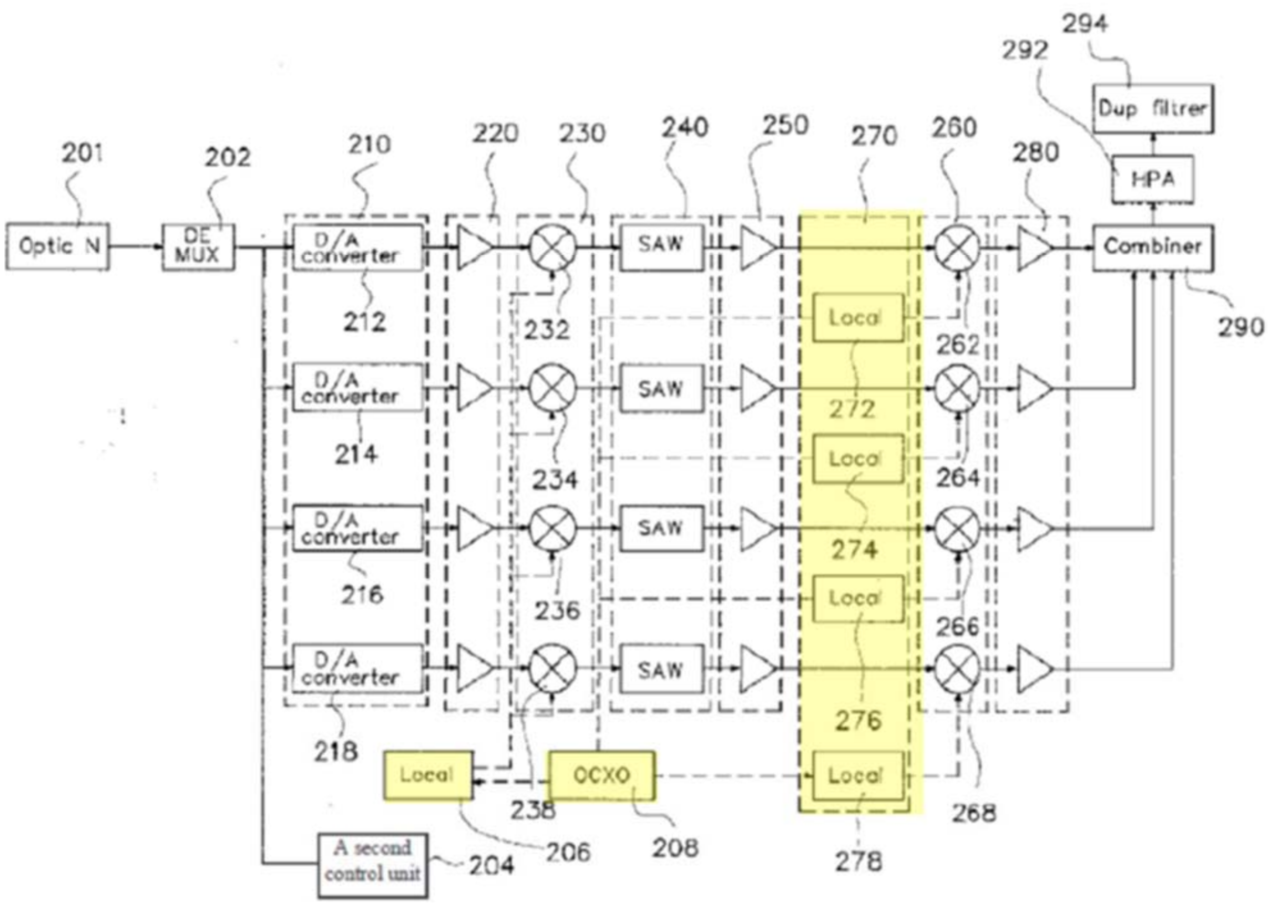


Oh renders obvious converting the digitized radio frequency spectrum to analog radio frequency signals comprises amplifying the analog radio frequency signals (amplification at 220, 250, 292 prior to transmission to the mobile terminals 40). Ex. 1005, ¶¶179-180.

18. Dependent Claim 32

Oh discloses the process of upconverting the component band analog signals after conversion to analog at 210 and prior to transmission to the mobile terminals, mixing operations are performed at 230 and 260 to bring the band components to their appropriate band frequencies. Ex. 1007, 3:50-61. Those mixing operations use signals from forward path oscillators 206, 272, 274, 276, and 278. The local oscillators are synchronized with the reference oven controlled crystal oscillator (OCXO) 208. *Id.*, 3:69-4:5.

FIG. 3



As noted above in addressing claim 27, the '982 patent states that frequency shifts are minimized when a common reference oscillator is used "as a master clock so that the down conversion of the RF signals is the same as the up conversion." Ex. 1001, 7:25-30. As further noted above in addressing claim 27, a POSITA would have considered it obvious to implement Oh's slave unit 30 using a single oven controlled reference oscillator for both forward and reverse frequency conversions.

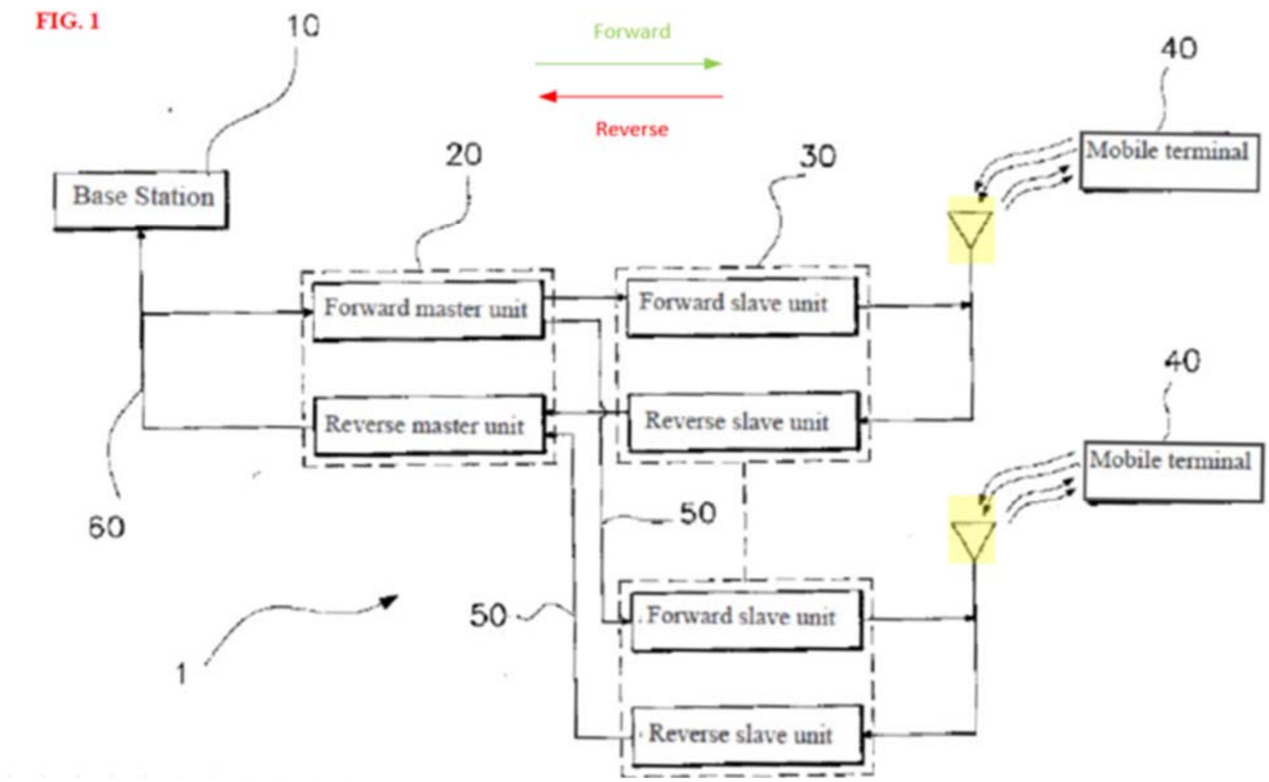
Oh renders obvious converting the digitized radio frequency spectrum to analog radio frequency signals comprises synchronizing a forward path local oscillator (local oscillators 206, 272, 274, 276, 278) to a reference oscillator (208) so as to reduce end-to-end frequency translation. Ex. 1005, ¶¶181-183.

19. Independent Claim 34

The preamble of claim 34 is rendered obvious for the reasons discussed for the preamble to claim 1. Elements 1 and 2 are rendered obvious for the reasons of claim 1, elements 1 and 2, respectively. Element 3 is rendered obvious for the reasons of claim 5. Ex. 1005, ¶184.

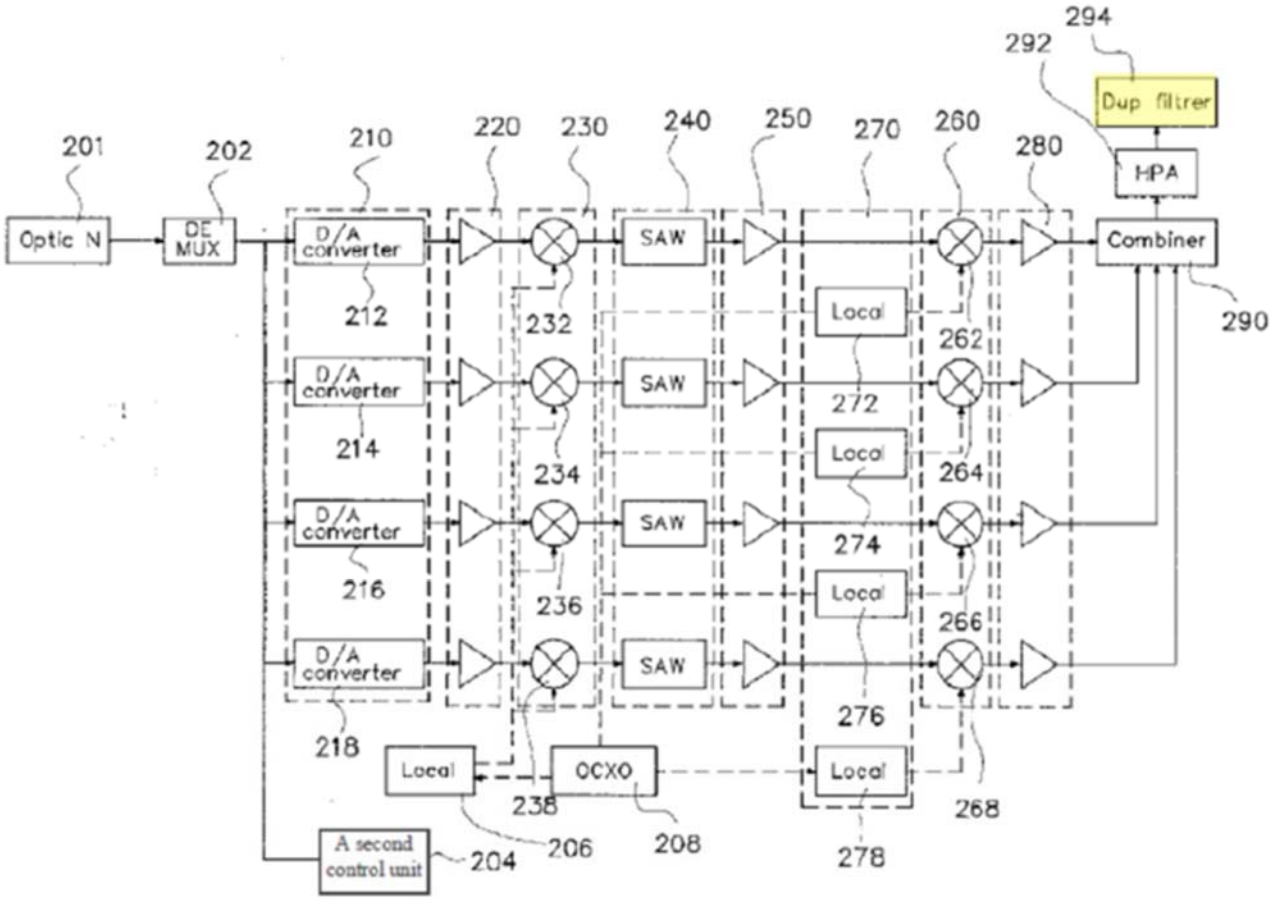
(a) Element 4: "a duplexer coupled to the main radio frequency antenna which receives radio frequency signals in the reverse path and transmits radio frequency signals in the forward path;"

Oh's remote slave units 30 include bi-directional filters, shown in the forward path of Fig. 3 at 294 and the reverse path of Fig. 4 at 301.



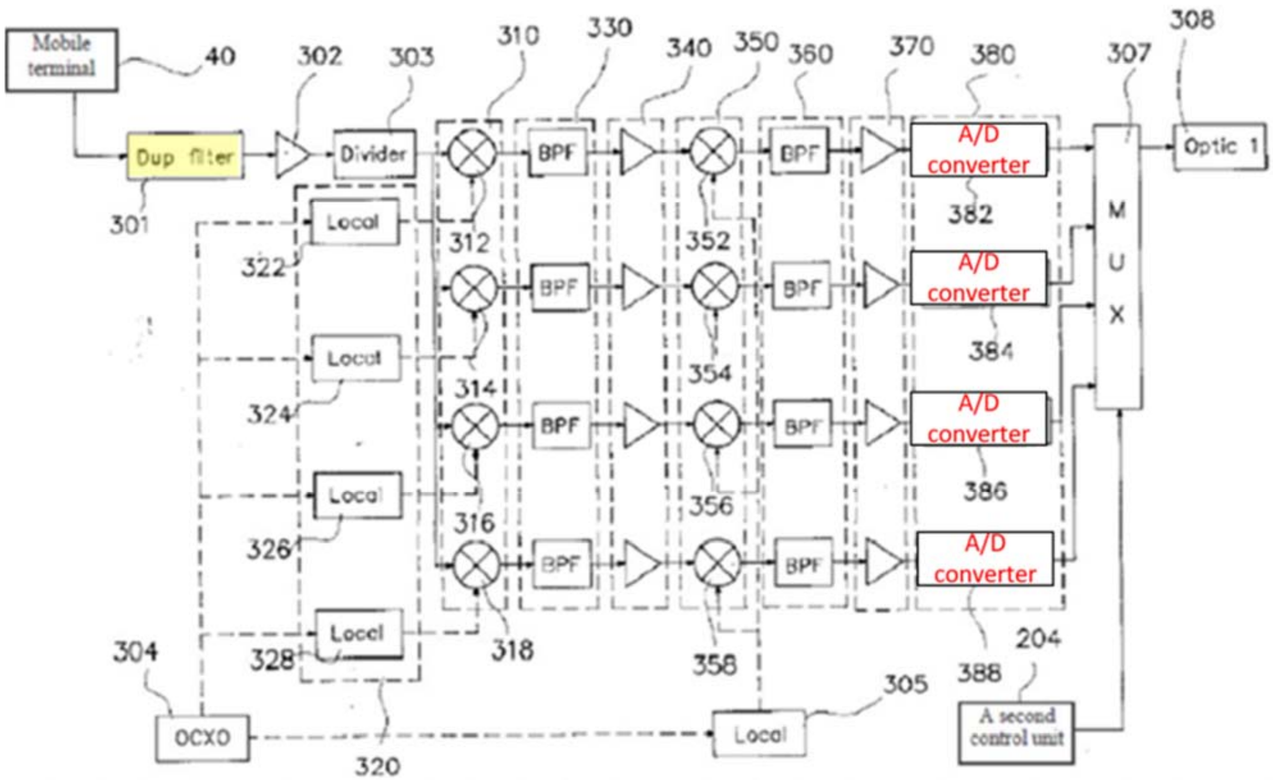
In the forward path, said "second combiner 290 combines the RF signals of different frequency bands transmitted from four mixers [*i.e.*, analog combining (Ex. 1005, ¶58)], respectively, comprising a sixth mixer unit 260, amplifies the strength and level at a second power amplifier 292, and transmits them to a mobile terminals 40 through a second bi-directional filter 294, allowing the mobile terminals 40 to receive the RF signals generated from the base station 10 through the optic repeater in a streamline manner." Ex. 1007, 4:10-14.

FIG. 3



In the reverse path, slave unit 30 "converts the RF signals, analog signals, transmitted from the mobile terminals 40 through a third bi-directional filter 301, to the digital signals; and transmits them to the master unit 20." *Id.*, 4:24-25.

FIG. 4



Oh renders obvious a duplexer (duplex filter 294, 301) coupled to the main radio frequency antenna (shown in Fig. 1) which receives radio frequency signals in the reverse path and transmits radio frequency signals in the forward path (to mobile terminals 40). Ex. 1005, ¶¶185-186.

(b) Elements 5 and 6

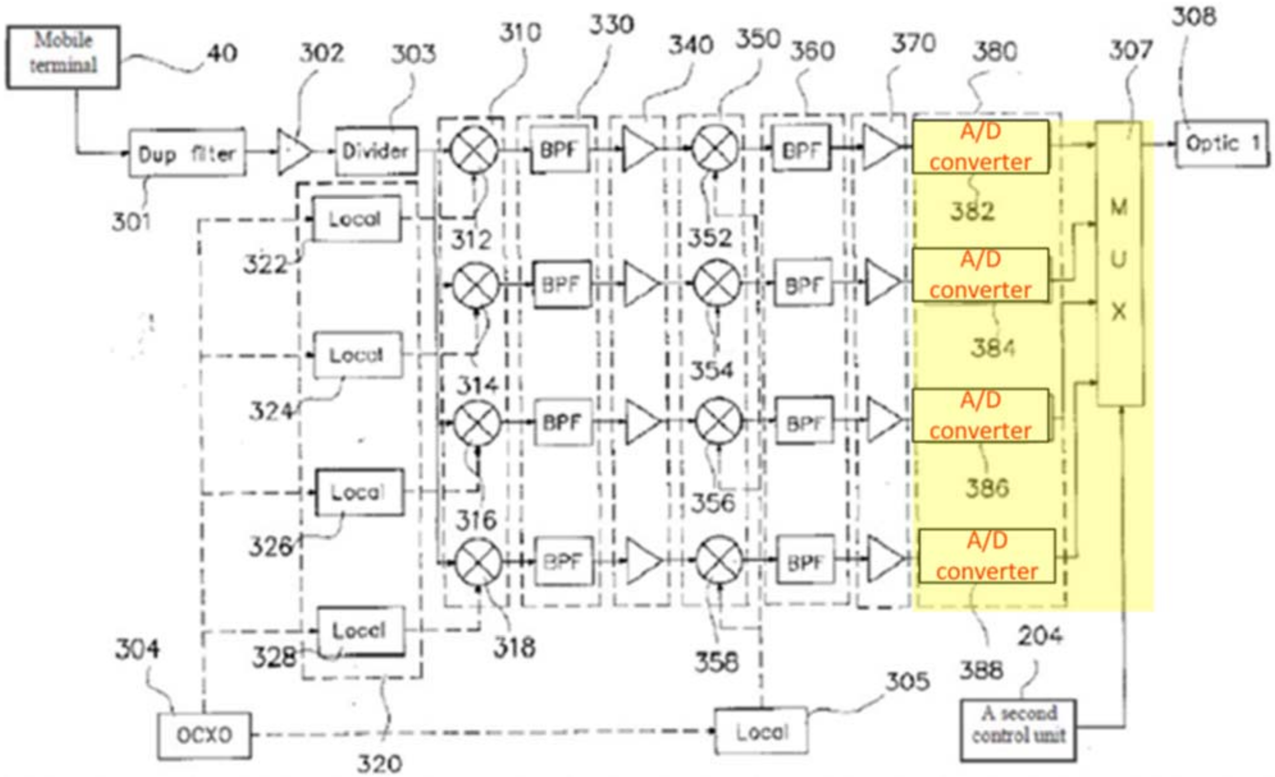
Regarding element 5, Oh discloses a radio frequency to digital converter coupled to the duplexer 294, 301 in the reverse path for the reasons represented above for claim 25, element 2.

Regarding element 6, Oh discloses a digital to radio frequency converter coupled to the duplexer 294, 301 in the forward path for the reasons represented above for claim 28, element 5. Ex. 1005, ¶187.

(c) Element 7: "a multiplexer chip set coupled to the radio frequency to digital converter in the reverse path and the digital to radio frequency converter in the forward path;"

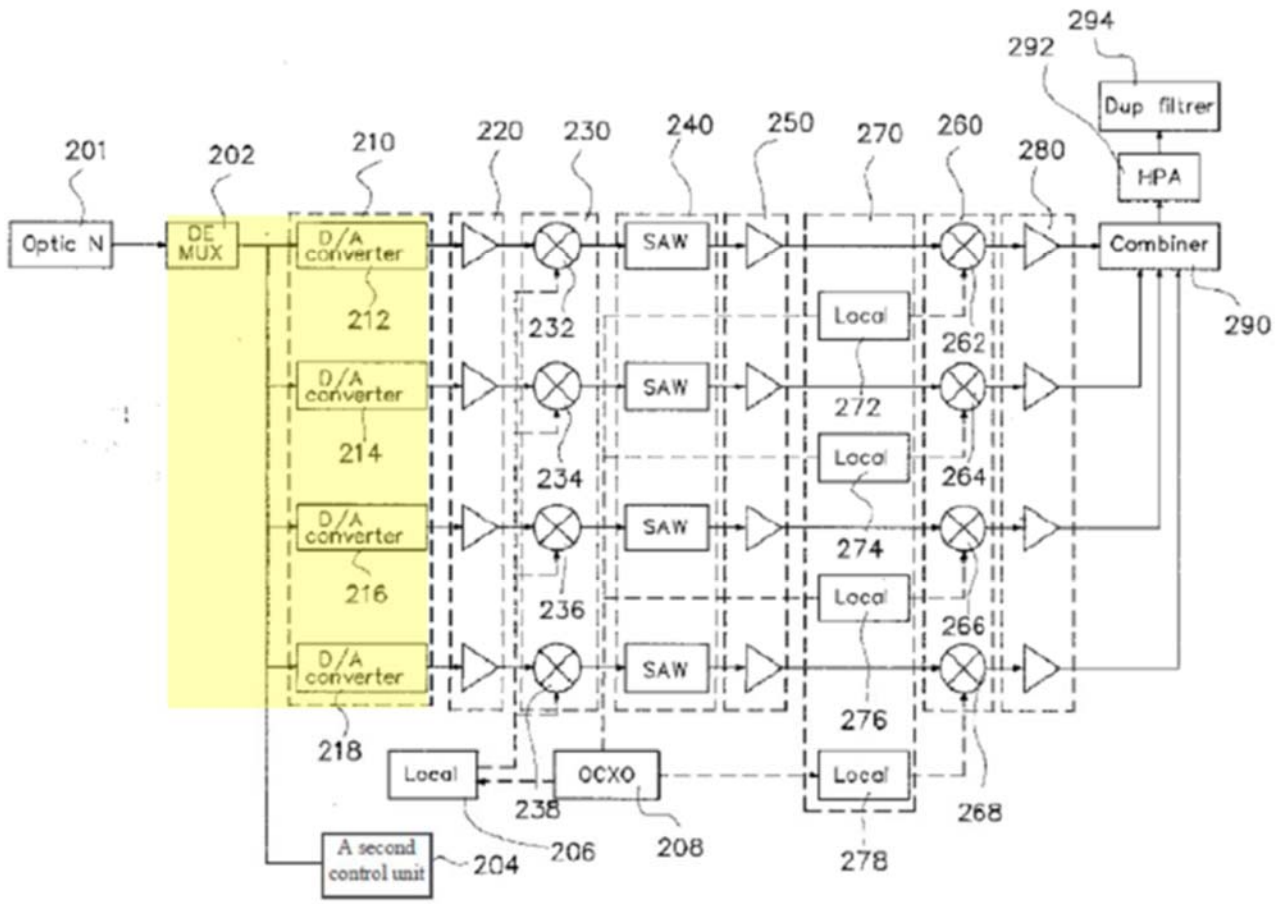
Oh's slave units 30 each include multiplexer/demultiplexer components. On the reverse path, A/D converter unit 380 are coupled to multiplexer 307 to serialize the digital samples for transmission to master unit 20 for recreation of the analog signal received from the antenna. *Id.*, 4:36-39.

FIG. 4



On the forward path, demultiplexer 202 routes digital sample data from the master unit 20 to the D/A converter 210 of the corresponding row of components for processing that frequency band of the analog signal to be transmitted to the mobile terminals 40. Ex. 1007, 3:50-53.

FIG. 3



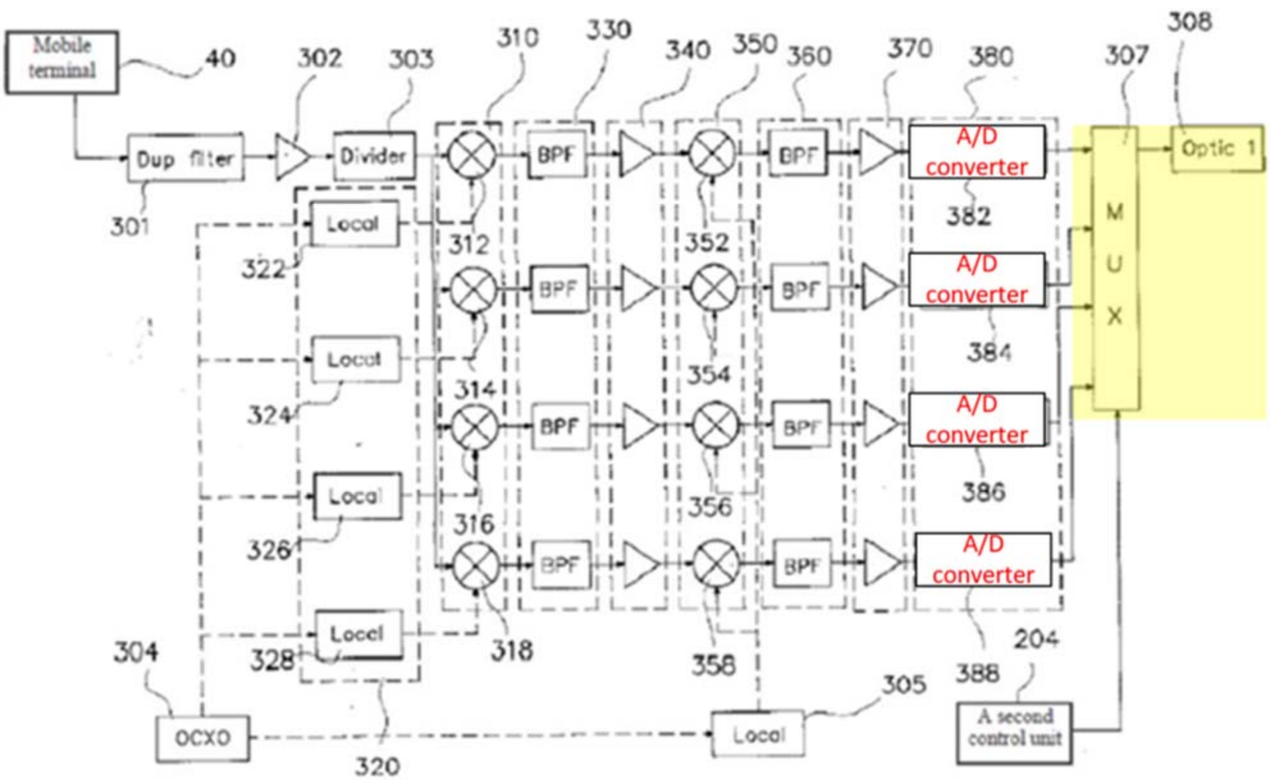
With multiplexer 307 and demultiplexer 210 being in the same slave unit 30, a POSITA would recognize 307 and 210 as multiplexer chip set. Multiplexer chip sets for use with optical-fiber networks were well known as of 2000 and a matter of design choice, as evidenced by Ex. 1011, "A 10-GHz 8-b multiplexer/demultiplexer chip set for the SONET STS-192 system," IEEE Dec. 1991.

Oh renders obvious a multiplexer chip set (307, 210) coupled to the radio frequency to digital converter (380) in the reverse path and the digital to radio frequency converter (210) in the forward path. Ex. 1005, ¶¶188-191.

(d) Element 8: "an optical transmitter coupled to an output of the multiplexer chip set;"

On the reverse path, multiplexer 307 is coupled to optic converter unit 308. Ex. 1005, ¶192.

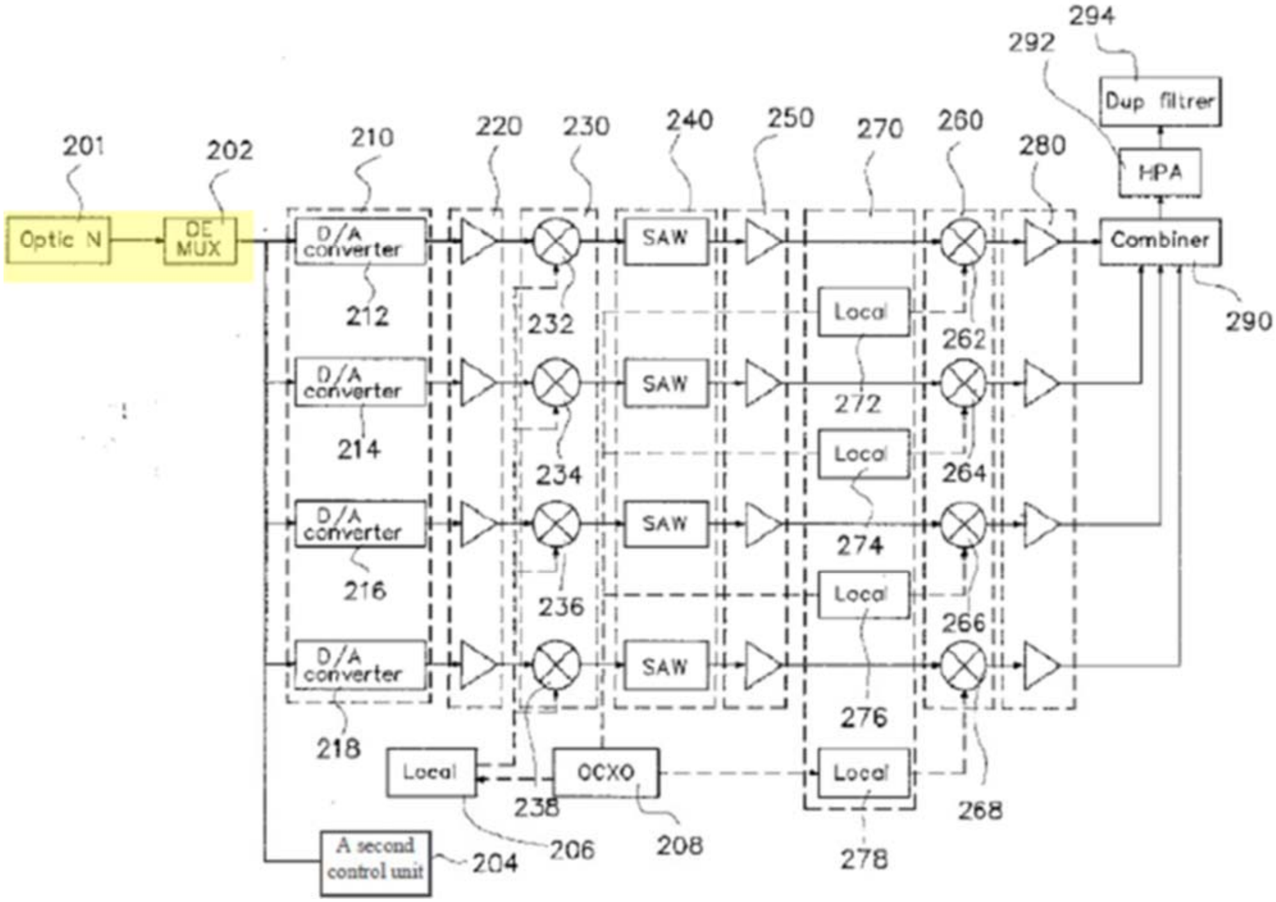
FIG. 4



(e) Element 9: "an optical receiver coupled to an input of the multiplexer chip set;"

On the forward path, demultiplexer 202 is coupled to optical converter unit 201 that receives digital data from master unit 20 over optic line 50. Ex. 1005, ¶193.

FIG. 3



(f) Elements 10 and 11

Regarding element 10, Oh discloses the claimed shared circuitry for the reasons presented above for claim 1, element 2b. And for element 11, Oh discloses the claimed digital summing operation for the reasons presented for claim 1, element 3. Ex. 1005, ¶194.

20. Dependent Claim 35

Oh renders obvious the limitation of claim 35 for the reasons above for claim 8. Ex. 1005, ¶195.

21. Independent Claim 37

(a) Preamble and element 1: "A first unit comprising: an interface to communicatively couple the first unit to a plurality of second units using at least one communication medium, wherein the plurality of second units are located remotely from the first unit;"

Oh discloses master unit 20 is coupled to multiple remote slave units 30 via optic lines 50.

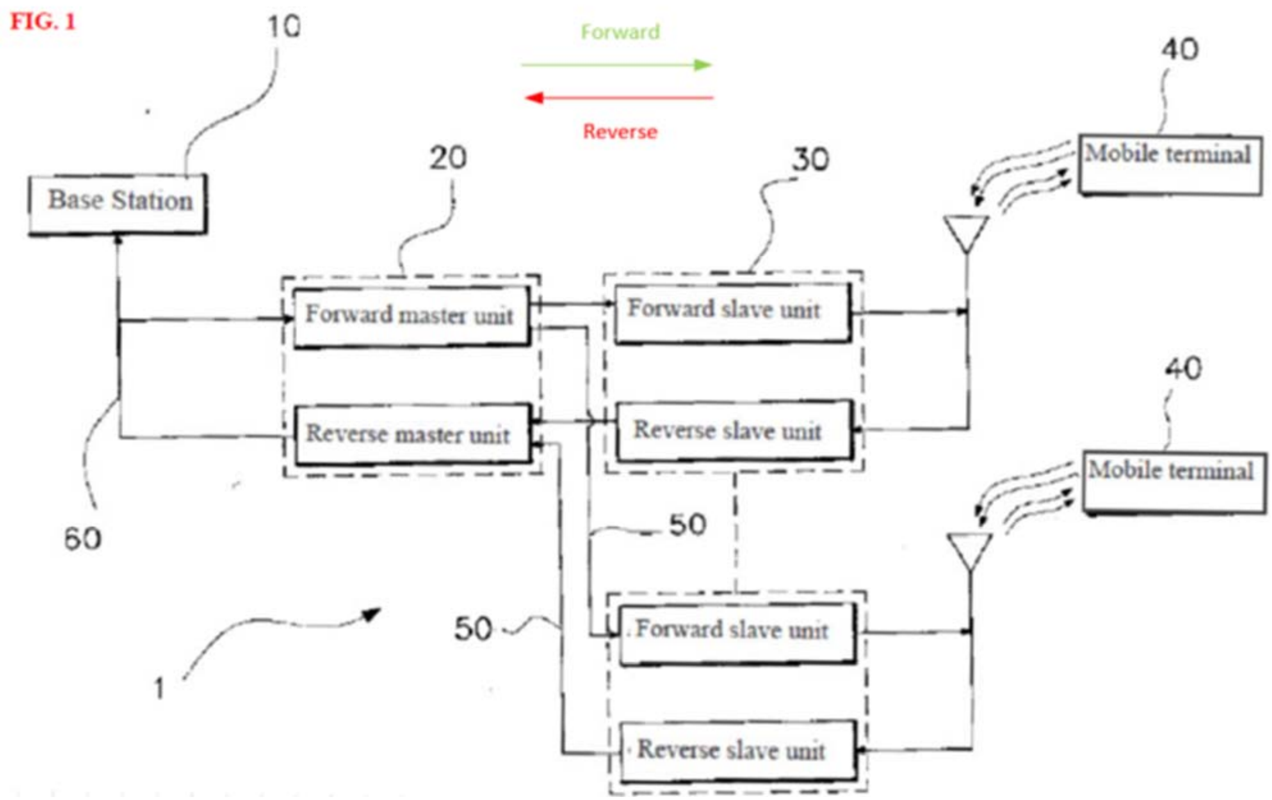
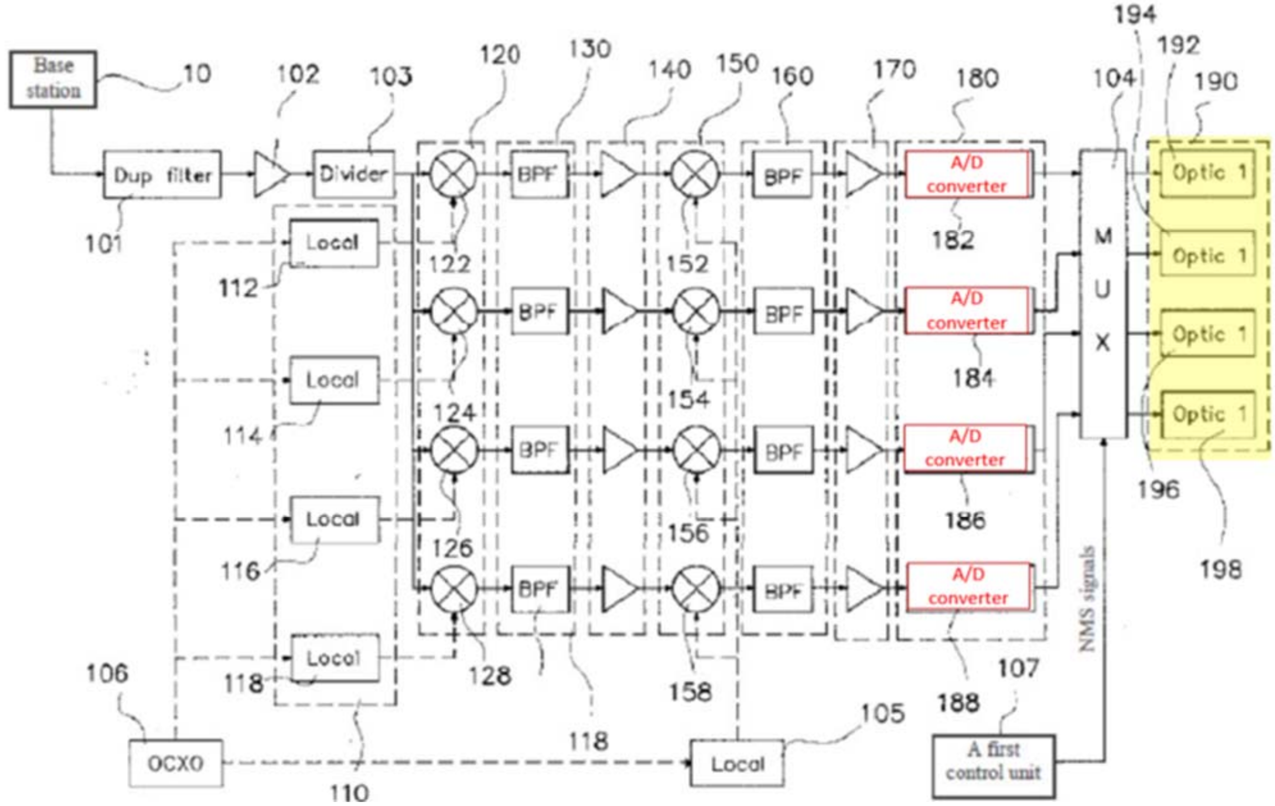


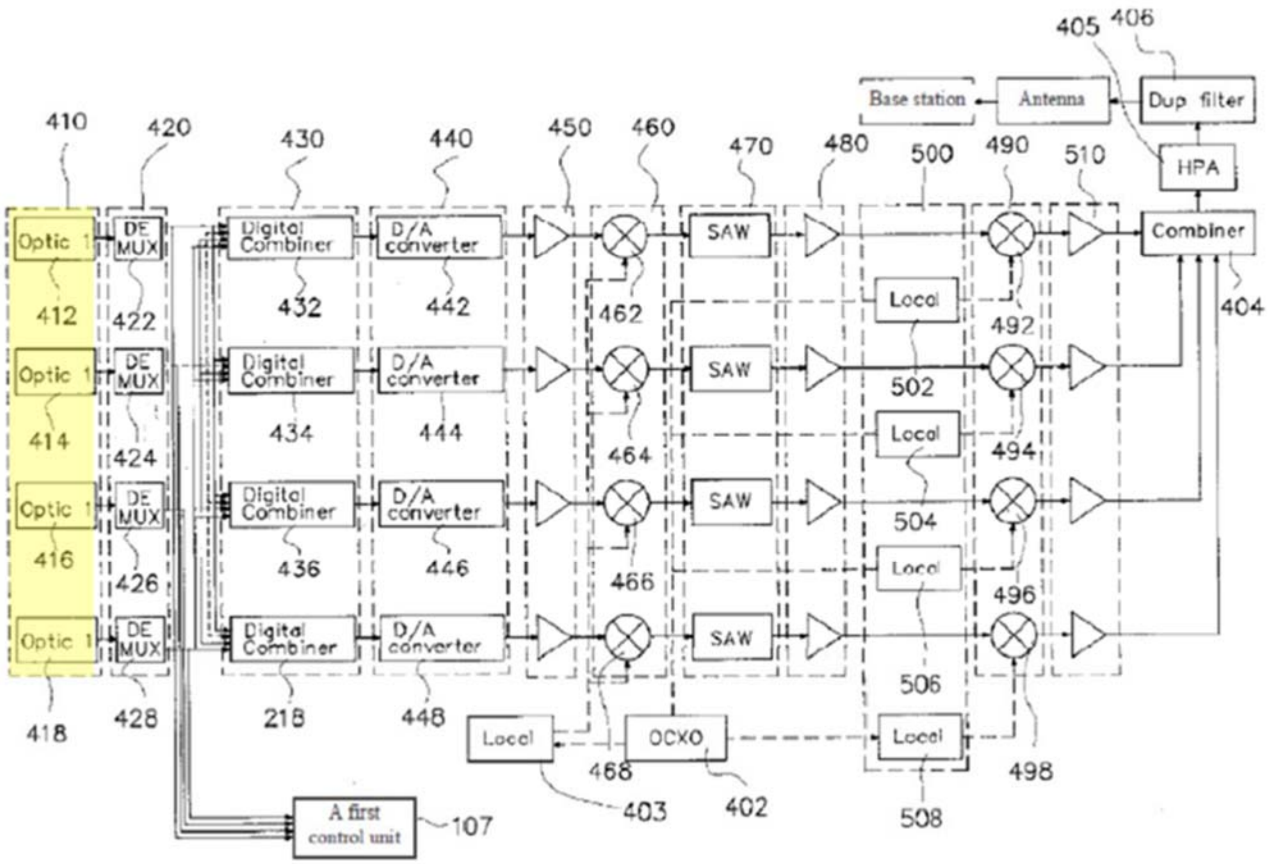
Fig. 2 of Oh depicts optic converter unit 190 that provides a downstream interface between master unit 20 and remote slave units 30.

FIG. 2



And Fig. 5 illustrates optic converter unit 410 that provides an upstream interface from slave units 30 to master unit 20.

FIG. 5



Oh renders obvious a first unit (20) comprising: an interface (190, 410) to communicatively couple the first unit to a plurality of second units (30) using at least one communication medium, (50) wherein the plurality of second units are located remotely from the first unit. Ex. 1005, ¶¶196-199.

(b) Elements 2-4

Regarding element 2, Oh discloses the claimed analog-to-digital unit 180 for digitizing an analog signal from a base station 10 for the reasons provided for claim 28, element 2.

Regarding element 3, Oh discloses the claimed D/A converter unit 440 for the reasons provided for claim 25, element 6.

Regarding element 4, Oh discloses the claimed digital summer 430 for the reasons provided above for claim 1, element 3. Ex. 1005, ¶200.

(c) Element 5: "wherein the upstream digital RF samples received from the plurality of second units have an associated resolution;"

Oh discloses that its A/D converters sample the downconverted analog signals at each frequency band at 12-bits of resolution. Ex. 1007, 3:38-39; 3:61-64; 4:16. On the reverse path at the master unit 20, digital combiners 432, 434, 436, 438 perform digital combining by "creating 14-bit intermediate frequency signals by combining four 12-bit intermediate frequency signals in the same frequency band." *Id*., 5:16-17; Ex. 1005, ¶58.

Oh renders obvious wherein the upstream digital RF samples received from the plurality of second units have an associated resolution (12-bit resolution). Ex. 1005, ¶201.

(d) Element 6: "wherein the digital summer has a resolution that is greater than the resolution associated with the digitized radio frequency signals being digitally summed;"

As noted above, on the reverse path at the master unit 20, digital combiners 432, 434, 436, 438 perform digital combining by "creating 14-bit intermediate frequency signals by combining four 12-bit intermediate frequency signals in the same frequency band." *Id*., 5:16-17; Ex. 1005, ¶58.

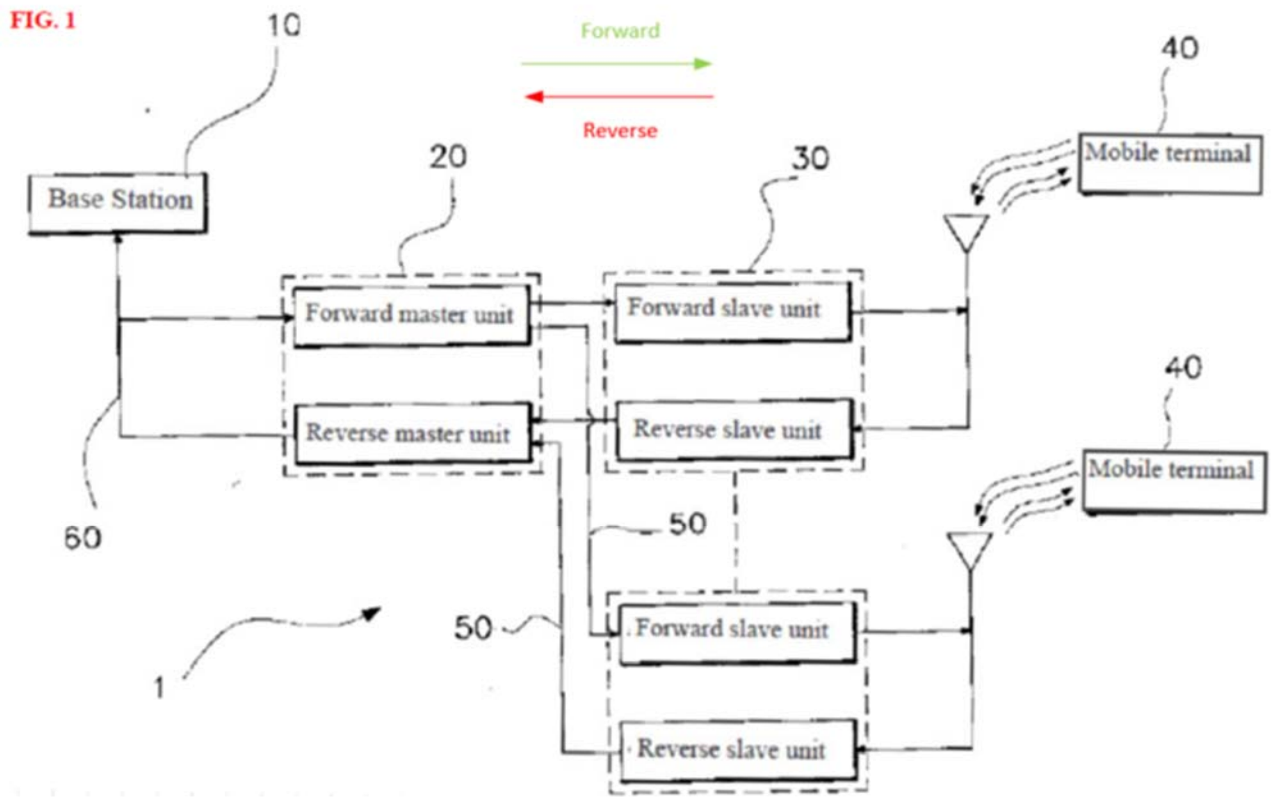
Oh renders obvious wherein the digital summer has a resolution (14 bits) that is greater than the resolution associated with the digitized radio frequency signals being digitally summed (12 bits). Ex. 1005, ¶202.

(e) Element 7

Regarding element 7, Oh discloses downstream transmission of digital samples for the reasons provided for claim 28, element 3. Ex. 1005, ¶203.

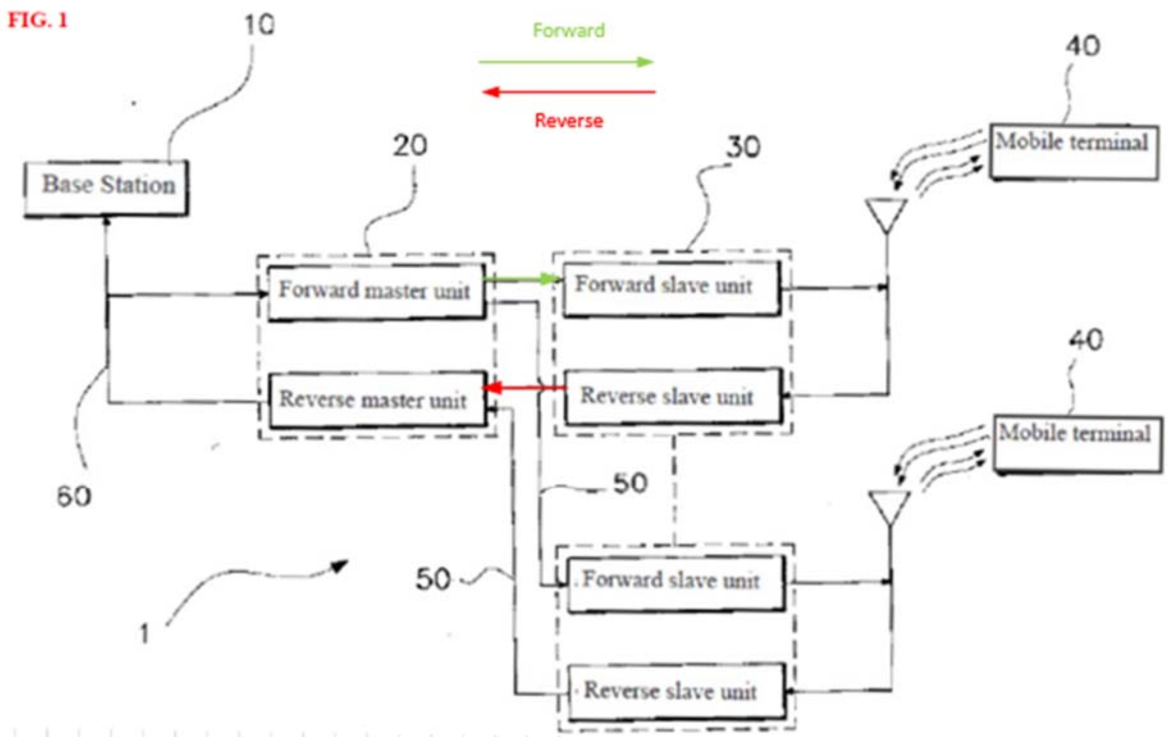
22. Dependent Claim 38

Oh discloses that the master unit 20 communicates digital data to slave units 30 via optic lines 50. Ex. 1007, 3:4-6. Optic lines were known to be of two types, either single mode or multi-mode. Thus a POSITA would have considered it obvious to select one of the two possible choices to implement optic lines 50, where the claim encompasses both possible choices. Ex. 1005, ¶204; *see also*, Ex. 1022 (Farber).



23. Dependent Claim 39

Oh Fig. 1 illustrates master unit 20 communicating in the forward direction to a slave unit 30 using a first optic line 50, highlighted in green, and in the reverse direction from a slave unit using a second optic line 50 highlighted in red.



Oh renders obvious the interface (Fig. 2, 190; Fig. 4 410) is operable to communicatively couple the first unit (20) to at least one second unit (30) using a pair of optical fibers, wherein a first optical fiber (50, green) included in the pair is used to communicate the at least a portion of the downstream digital RF samples to the at least one second unit and a second optical fiber (50, red) included in the pair is used to receive respective upstream digital RF samples from the at least one second unit. Ex. 1005, ¶¶205-207.

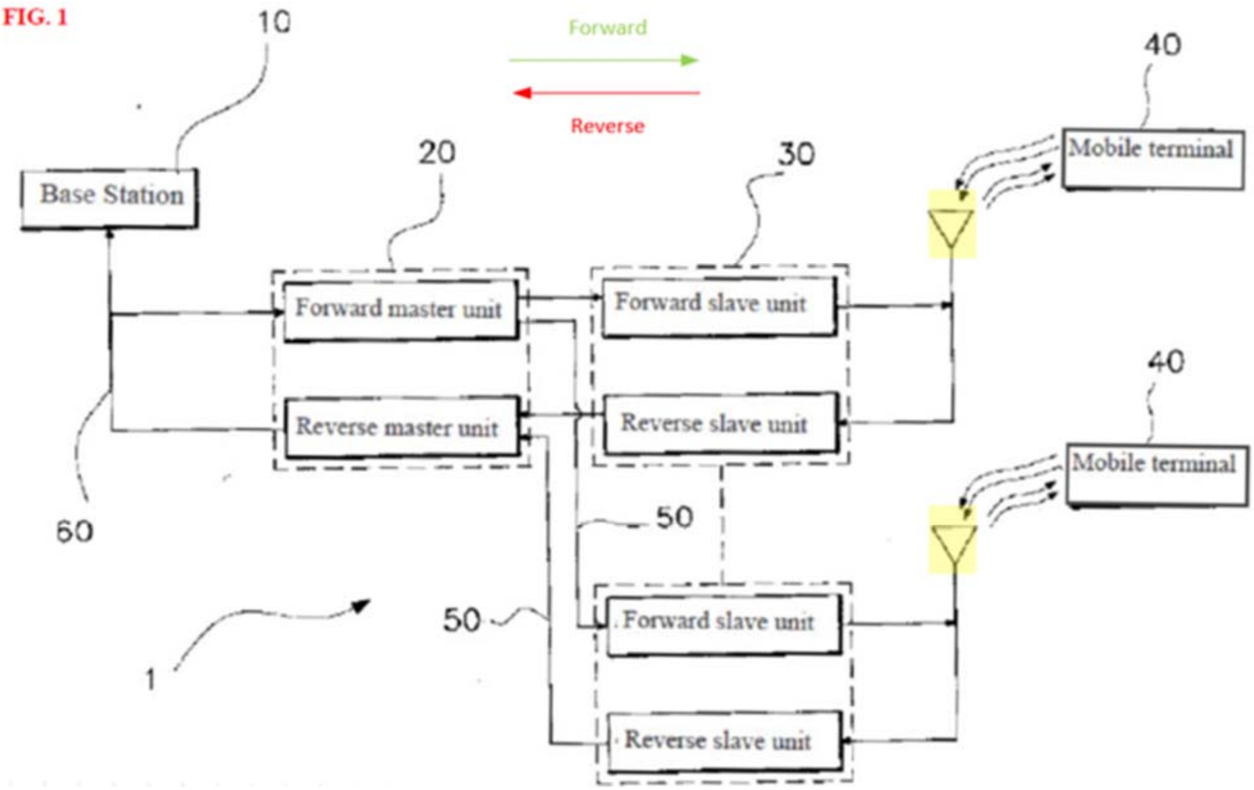
24. Dependent Claim 40

Oh discloses a digital host unit for the reasons provided above for claim 1, element 1. Ex. 1005, ¶208.

25. Dependent Claim 41

Oh discloses multiple remote slave units 30, each slave unit 30 including an antenna for communicating with mobile terminals 40. Because each slave unit 30 includes an antenna that is remote from master unit 20, slave units 30 are "remote antenna units."

FIG. 1

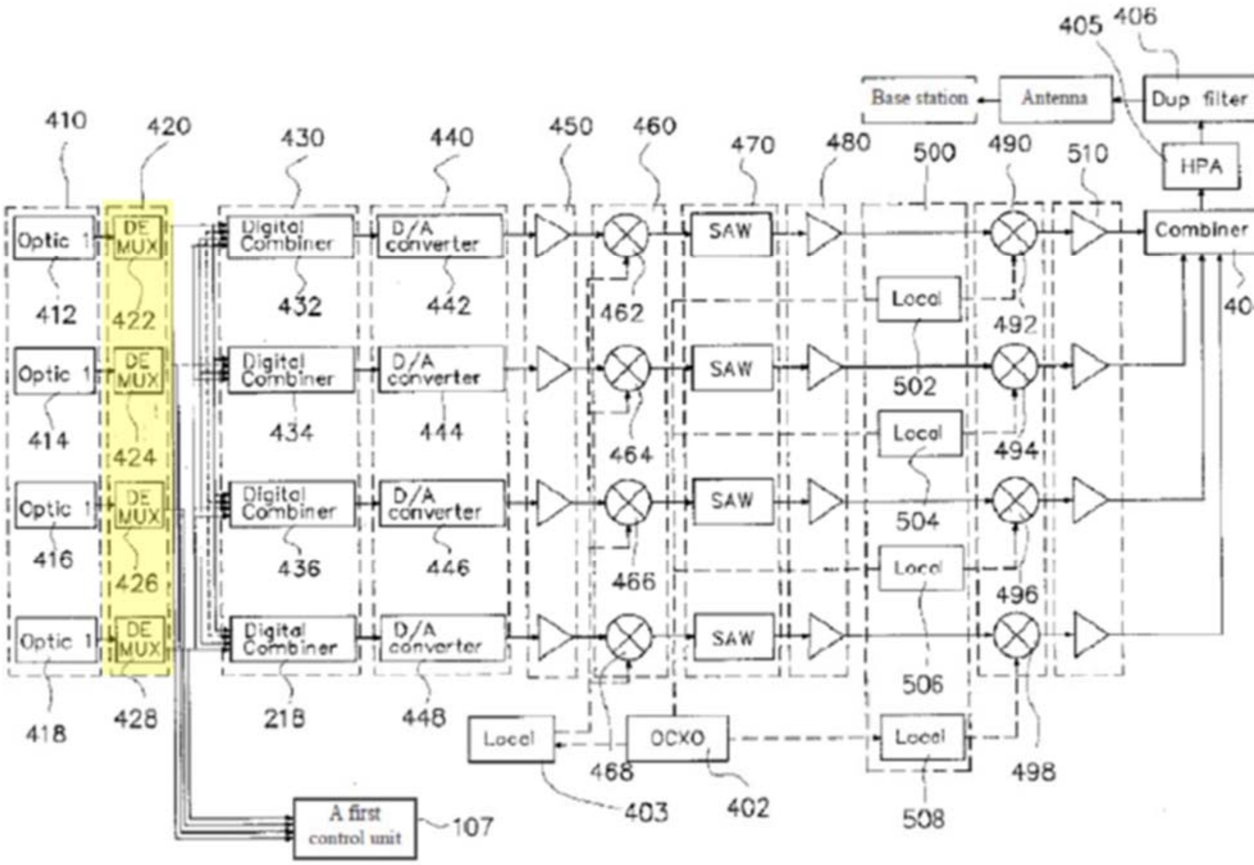


Oh renders obvious each of the plurality of second units (30) comprises at least one of a remote antenna unit and a remote expansion unit (*i.e.*, a remote antenna unit). Ex. 1005, ¶¶209-210.

26. Dependent Claim 42

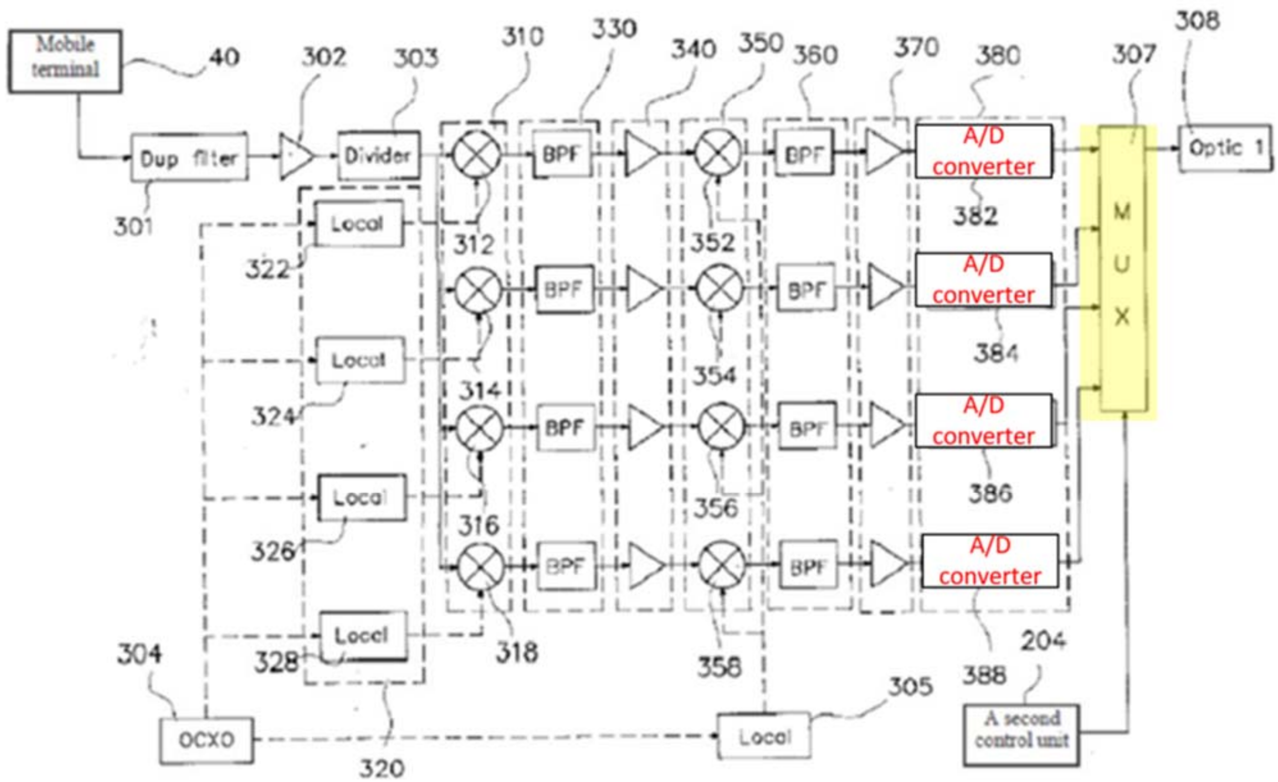
Fig. 5 of Oh discloses four demultiplexers 422, 424, 426, 428 at master unit 20, each one configured to handle data from a respective remote slave unit 30. Ex. 1007, 4:65-70.

FIG. 5



Multiplexer 307 of slave units 30 multiplexes four 12-bit digital samples, one for each frequency band, and 4-bit control data from 204 into 52-bit serial data signals. *Id.*, 4:56-59.

FIG. 4



Demultiplexers 422, 424, 426, 428 of Fig. 5 then demultiplex those serial data signals, each sending one 12-bit sample to each of the digital combiners associated with one frequency band each, and the 4 bits of control data to control unit 107.

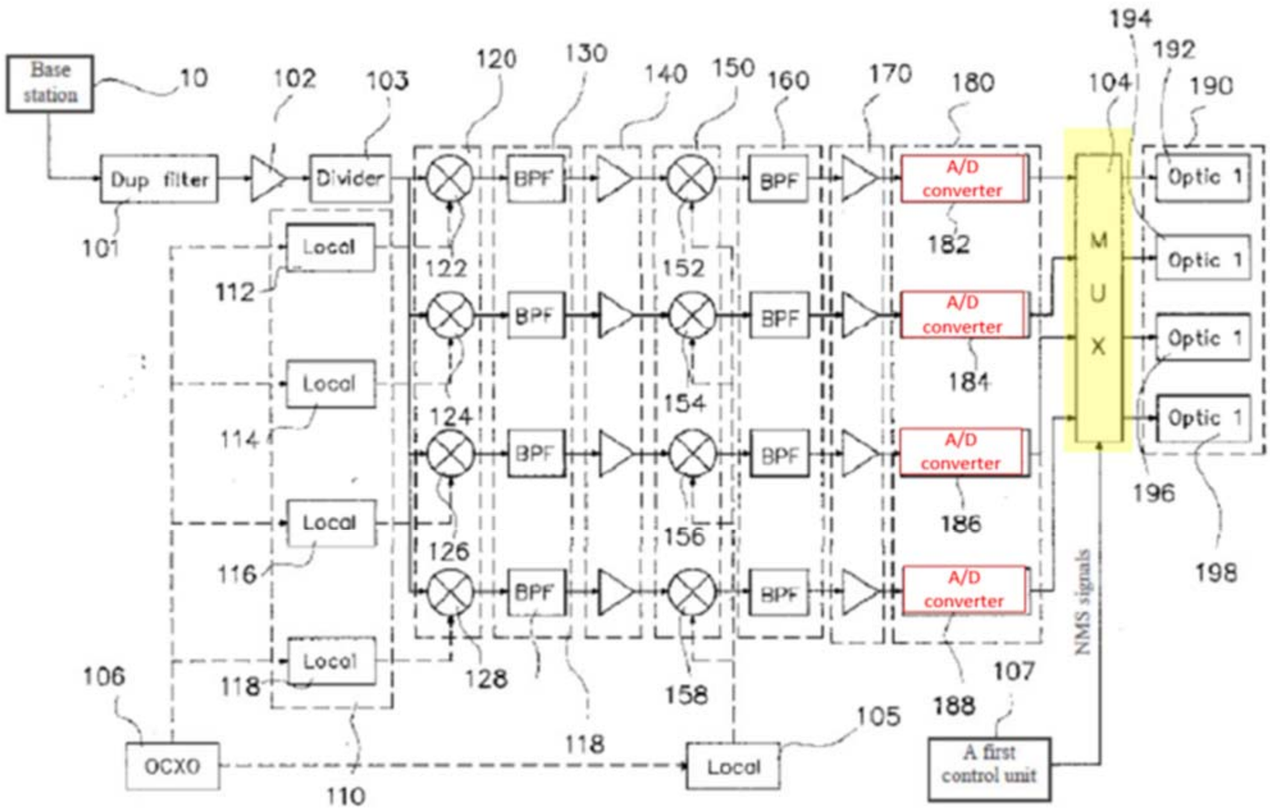
Oh renders obvious a respective demultiplexer (422, 424, 426, 428) for each of the plurality of second units (slave units 30), wherein each of the demultiplexers extracts the first digital samples (12-bit data samples) from a framed serial bit stream (52-bit serial data signals) received from a respective one of the plurality of second units. Ex. 1005, ¶¶211-214.

27. Dependent Claim 43

All-digital signals from A/D converter 180 unit are multiplexed by multiplexer

104 prior to transmission to multiple remote slave units 30 over optic lines 50. Multiplexer 104 multiplexes four 12-bit digital samples, one for each frequency band, and 4-bit control data from 107 into 52-bit serial data signals. *Id*., 3:38-44.

FIG. 2



Oh renders obvious a multiplexer (104) to produce a framed serial bit stream (52-bit word frames) from the second digital samples (12-bit samples taken at 180), wherein the framed serial bit stream is communicated to the plurality of second units (30). Ex. 1005, ¶¶215-216.

28. Dependent Claim 44

A POSITA would understand optic receiver 410 to include a phase locked loop or other mechanism for extracting timing data. Wherever a serial communication channel does not transmit a clock signal along with the data stream, the clock must be regenerated at the receiver, using timing information extracted from the data stream. Ex. 1005, ¶217. In high data rate systems, the receiver typically generates a clock from an approximate frequency reference and then phase-aligns its clock to transitions in the data stream with a phase locked loop.

To the extent that a clock recovery circuit is not obvious to a POSITA, it is obvious based on Oh in view of Bodeep. Ex. 1014. Bodeep discloses a clock recovery circuit 346 at the end of an optical link 420 that is used by a receive detector 352 to receive data. Ex. 1014, Fig. 3, 4:31-5:10. A POSITA would be motivated to incorporate a clock recovery circuit 346 at an Oh entity that receives data across an optic line 50 because such a clock recovery circuit 346 would allow received high speed data to be extracted without a need for clock signal data to be transmitted across the optic line 50, simplifying transmission and reducing power consumption. Ex. 1005, ¶¶217-218.

29. Independent Claim 45

Oh renders obvious the elements of claim 45 for the reasons presented above as follows:

<u>Element</u>	<u>Analogous Element Addressed Above</u>
Preamble, 1, 2	Claim 1, Preamble, Element 1, Elements 2a, 2b

3-6	Claim 37, Elements 1-4
7	Claim 28, Element 3
8	Upstream digitization and transmission to host: Claim 25, Elements 2-3 Resolution: Claim 37, Element 5
9	Claim 28, Element 5
10	Claim 37, Element 6

Ex. 1005, ¶219.

30. Dependent Claims 46-50

Oh renders claim 46-49 obvious for the reasons provided above for claims 40-44. Ex. 1005, ¶220.

31. Independent Claim 51

Regarding the preamble and elements 1 and 2 of claim 51, Oh discloses digitizing a downstream RF radio signal at a host unit and communicating digital data representative thereof to multiple remote units for the reasons provided above for claim 28, elements 2 and 3. The claimed digital summing operation of element 4 is rendered obvious by Oh for the reasons provided for claim 1, element 3. The resolution of the received digital samples (12-bits in Oh) from remote units and resolution of the summing (14-bits in Oh) recited in elements 3 and 4 of claim 51 are rendered obvious for the reasons provided above for claim 37, elements 5 and 6. Element 5 of claim 51 is rendered obvious for the reasons provided above for claim 25, element 6. Ex. 1005, ¶221.

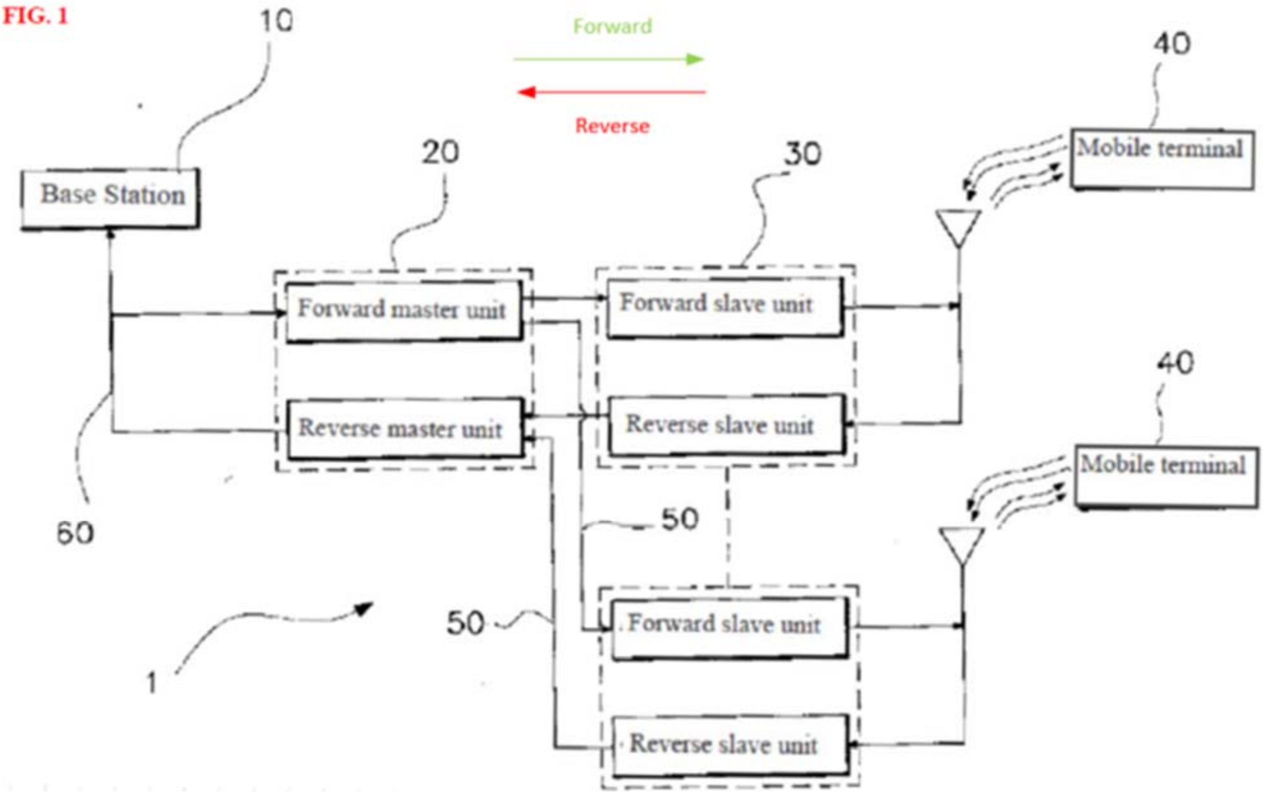
32. Independent Claim 81

(a) Preamble and Element 1: "A first unit comprising: means for communicatively coupling the first unit to a plurality of second units;"

The recited means for communicatively coupling is properly construed as having a function of "communicatively coupling the first unit to a plurality of second units" and corresponding structure of Optical Transmission Lines 414, 416 shown in Fig. 4 of the '982 patent.

Oh discloses optic lines 50 that communicatively couple master unit 20 to slave units 30.

FIG. 1



Oh renders obvious a first unit (master unit 20) comprising: means (optic lines 50) for communicatively coupling the first unit to a plurality of second units (30) by providing components that provide the same function, in the same way, with the same result as Optical Transmission Lines 414, 416 of the '982 patent. Ex. 1005, ¶¶222-224.

(b) Element 2: "means for digitizing an original downstream analog radio frequency signal in order to produce downstream digital RF samples;"

The recited means for digitizing is properly construed as having a function of "digitizing an original downstream analog radio frequency signal in order to produce downstream digital RF samples" and corresponding structure of Amplifier 450, Mixer 452, Amplifier/Filter 454, 456, 458, Mixer 460, A/D Converter 464 shown in Fig. 4 of the ’982 patent.

Oh discloses processing of a predetermined number of frequency bands as described at 3:9-11. Oh’s examples depict parallel processing of four frequency bands in each of Figs. 2-5 but contemplate more or fewer rows of processing. In the nominal case where an Oh configuration is used to digitize and relay a single frequency band, each of Figs. 2-5 would include a single row of processing (*e.g.*, 120, 130, 140, 150, 160, 170, 180 of Fig. 2).

Oh discloses components for digitizing an original downstream analog radio frequency in order to produce downstream digital RF samples in Fig. 2 that provide the same function, in the same way, to provide the same result as the corresponding structure of the ’982 patent when Oh is processing a single frequency band as follows:

’982 Structure	Corresponding Oh Structure
Amplifier 450	Amplifier 102
Mixer 452	First Mixer 122
Amplifier/Filter 454, 456, 458	Amplifier 140/Filter 130
Mixer 460	Mixer 152
A/D Converter 464	A/D Converter 182

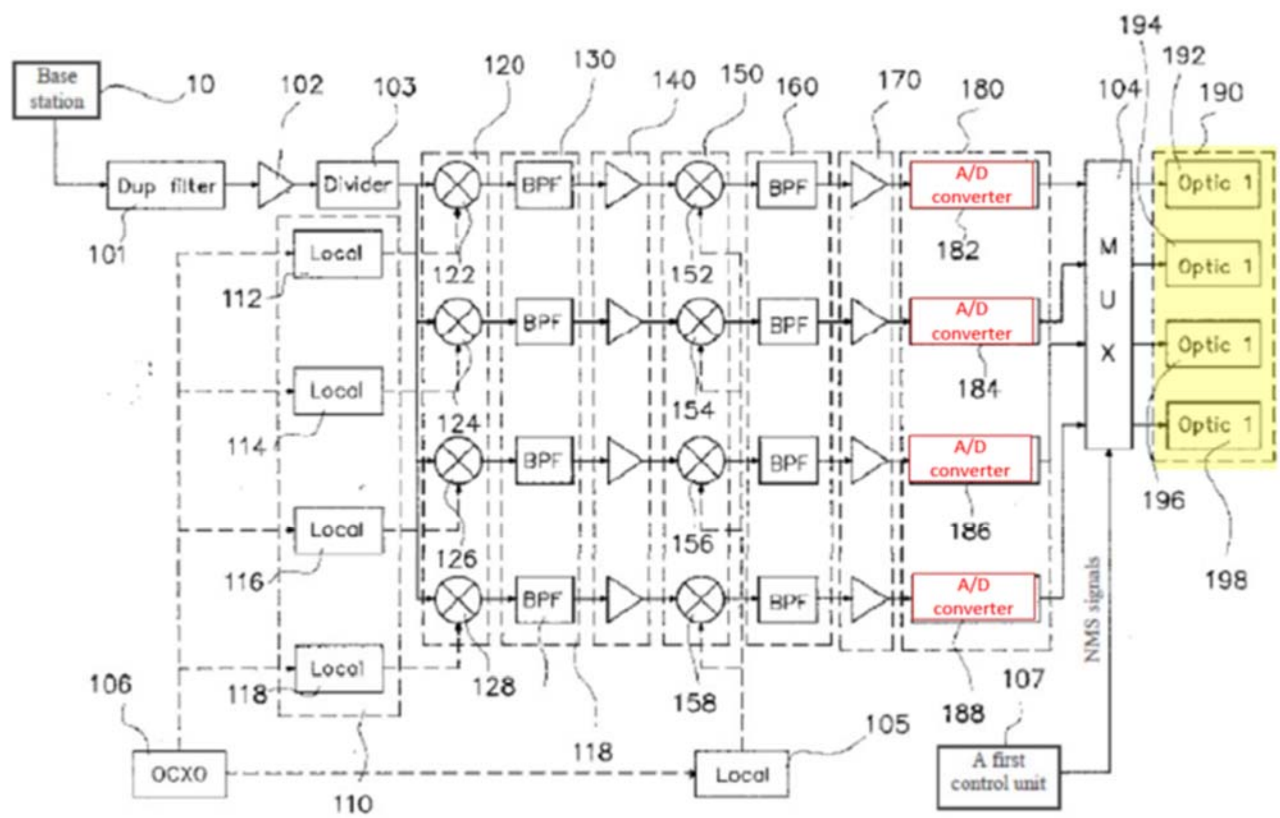
Oh renders Element 2 obvious. Ex. 1005, ¶¶225-227.

(c) Element 3: "means for communicating at least a portion of the downstream digital RF samples to the plurality of second units;"

The recited means for communicating is properly construed as having a function of "communicating at least a portion of the downstream digital RF samples to the plurality of second units" and corresponding structure of Optical Transmitters 431-1 – 431-P shown in Fig. 4 of the '982 patent.

Oh discloses communicating forward digital samples from master unit 20 to remote slave units 30 via optic converters 192, 194, 196, 198.

FIG. 2

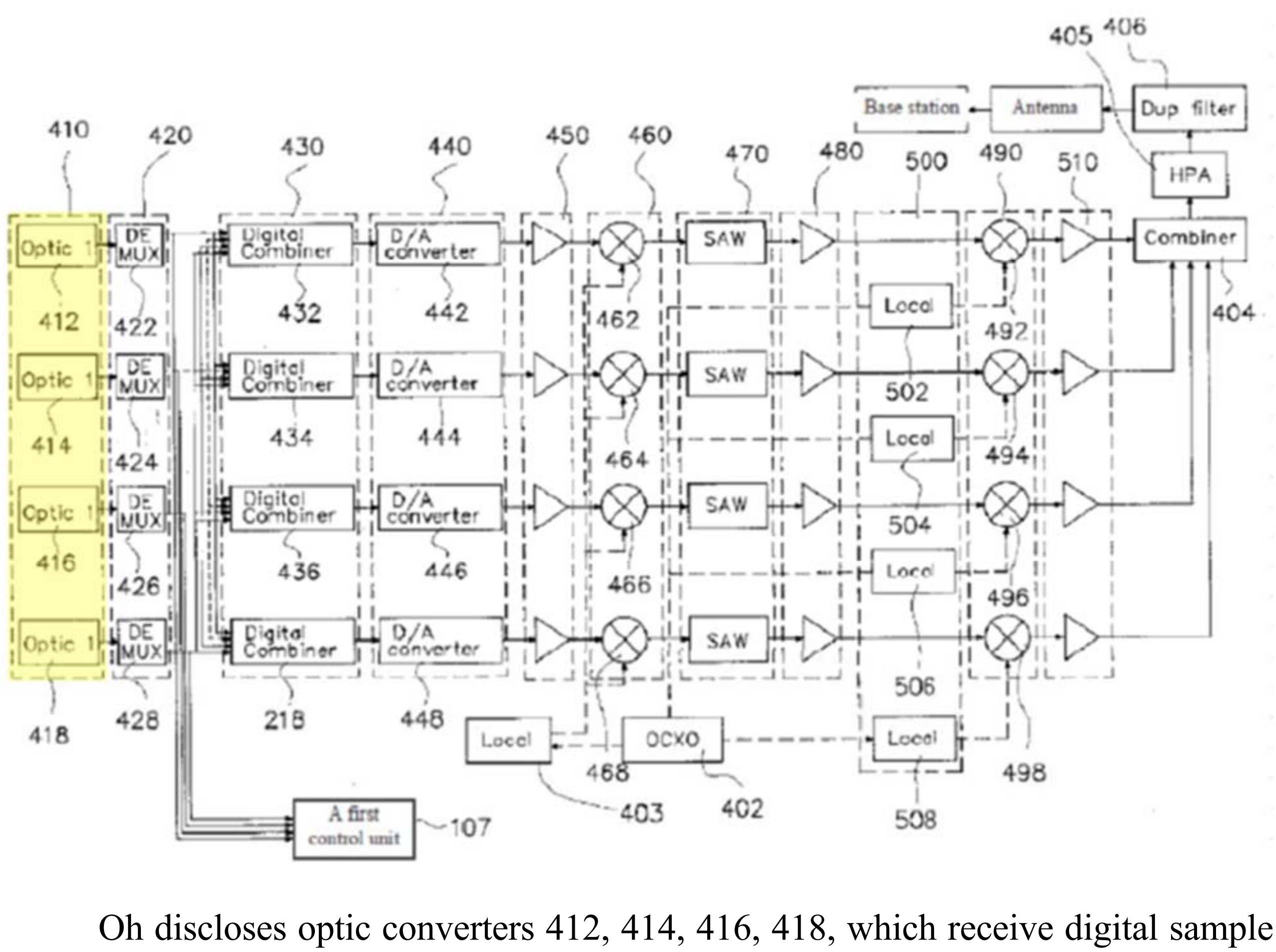


Oh renders obvious means (192, 194, 196, 198) for communicating at least a portion of the downstream digital RF samples to the plurality of second units (30) that provide the same function, in the same way, with the same result as Optical Transmitters 431-1 – 431-P of the '982 patent. Ex. 1005, ¶¶228-230.

(d) Element 4: "means for receiving from the plurality of second units respective upstream digital RF samples, the upstream digital RF samples having an associated resolution;"

The recited means for receiving is properly construed as having a function of "receiving from the plurality of second units respective upstream digital RF samples" and corresponding structure of Optical Receivers 418 shown in Fig. 4 of the '982 patent.

FIG. 5



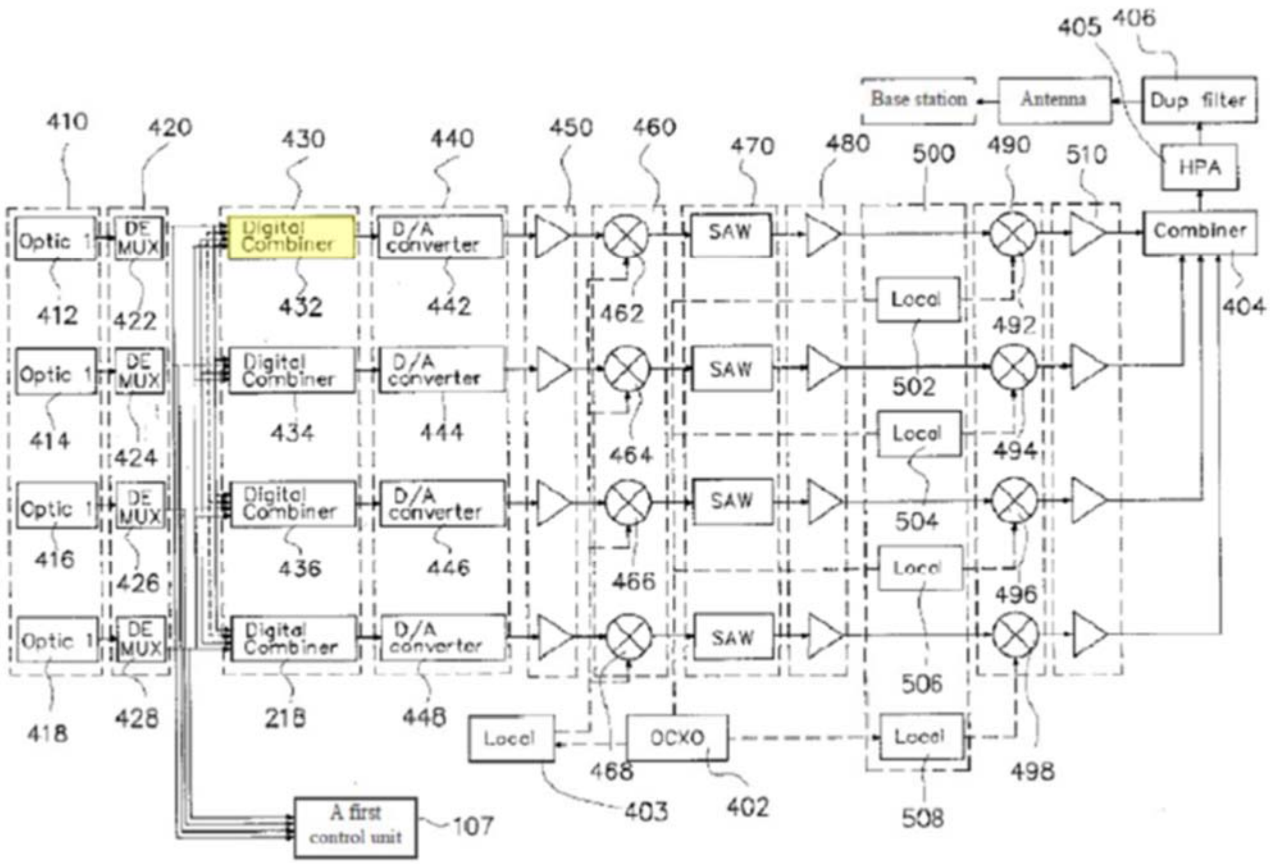
Oh discloses optic converters 412, 414, 416, 418, which receive digital sample data from the multiple remote slave units 30. In a nominal implementation where only one frequency band is processed, each of optic converters 412, 414, 416, 418 would receive 12-bit digital sample data of that band and a 4-bit control value from its respective slave unit 30. Demultiplexers 422, 424, 426, 428 would route the control data to 107 and would route the four 12-bit samples, one from each of the slave units 30, to digital combiners 432, 434, 436, 438 for summing (*i.e.*, digital combining). Ex. 1005, ¶58.

Oh discloses means (412, 414, 416, 418) for receiving from the plurality of second units (slave units 30) respective upstream digital RF samples, the upstream digital RF samples having an associated resolution (12-bit resolution) that provide the same function, in the same way, with the same result as Optical Receivers 418 of the ‘982 patent. Ex. 1005, ¶¶231-233.

(e) Element 5: "means for digitally summing respective upstream digital RF samples received from the plurality of second units in order to produce each of a stream of summed upstream digital RF samples, wherein the means for digitally summing has a resolution that is greater than the resolution of the upstream digital RF samples being summed;"

The recited means for digitally summing is properly construed as having a function of "digitally summing respective upstream digital RF samples received from the plurality of second units in order to produce each of a stream of summed upstream digital RF samples" and corresponding structure of Summer 498 shown in Fig. 4 of the ’982 patent. Oh's digital combiners 432, 434, 436, 438 "creat[e] 14-bit intermediate frequency signals by combining four 12-bit intermediate frequency signals," with one of those 12-bit digital samples being provided by each of four remote slave units 30. Ex. 1007, 5:16-17.

FIG. 5



Oh discloses means for digitally summing (430) respective upstream digital RF samples received from the plurality of second units (30) in order to produce each of a stream of summed upstream digital RF samples (output from 430), wherein the means for digitally summing has a resolution (14 bits) that is greater than the resolution of the upstream digital RF samples being summed (12 bits) that provide the same function, in the same way, with the same result as Summer 498 of the '982 patent. Ex.

1005, ¶¶234-235.

(f) Element 6: "means for converting the stream of summed upstream digital RF samples to a replicated upstream analog radio frequency."

The recited means for converting is properly construed as having a function of "converting the stream of summed upstream digital RF samples to a replicated upstream analog radio frequency" and corresponding structure of Fig. 4: D/A Converter 494, Mixer 492, Amplifier/Filter 488, 490, Mixer 486 shown in Fig. 4 of the '982 patent.

Oh discloses converting its 14-bit sum from 432 into an analog signal at 442 and upconverting the analog signal to the proper analog radio frequency via mixer 462, filter 470, amplifier 480 and mixer 490. Ex. 1007, 16-29.

Oh discloses components for converting the stream of summed upstream digital RF samples to a replicated upstream analog radio frequency in Fig. 5 that provide the same function, in the same way, to provide the same result as the corresponding structure of the '982 patent when Oh is processing a single frequency band as follows:

'982 Structure	Corresponding Oh Structure
D/A Converter 494	D/A Converter 442
Mixer 492	Mixer 462
Amplifier/Filter 488, 490	Amplifier/Filter 470, 480
Mixer 486	Mixer 492

Oh renders Element 6 obvious. Ex. 1005, ¶¶236-238.

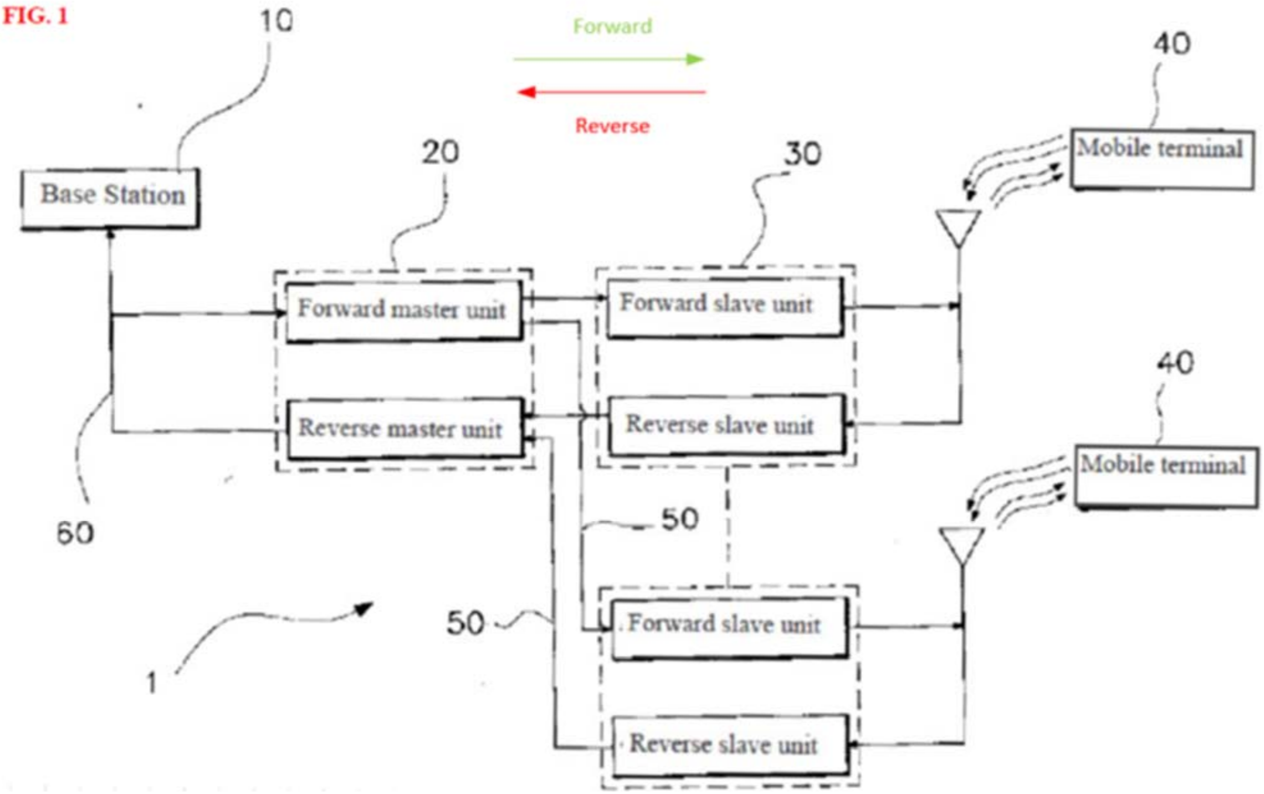
C. Ground 1b: Claims 75-80 Are Obvious Over Oh in view of Wala

1. Independent Claim 75

(a) Motivation to Combine

A POSITA would be motivated to combine Oh and Wala for several reasons. First, the Oh and Wala systems are highly compatible in that they both provide digital RF transport systems for extending RF communications into hard to reach areas, such as radio wave shadow areas. *Compare* Ex. 1007, 2:4-13; Ex. 1009, 585. Both Oh and Wala disclose forward transmissions with host units that receive RF signals, digitize those signals, forward the digitized signals to remote units via optical fiber, where the RF signals are recreated and wirelessly distributed via antennas. On the reverse path, both Oh and Wala receive RF signals via an antenna at remote units, the remote units digitize those signals and send them to the host unit via optical fiber, where the RF signals are recreated for transmission. *Compare*, Oh Fig. 1, Wala Fig. 1.

FIG. 1



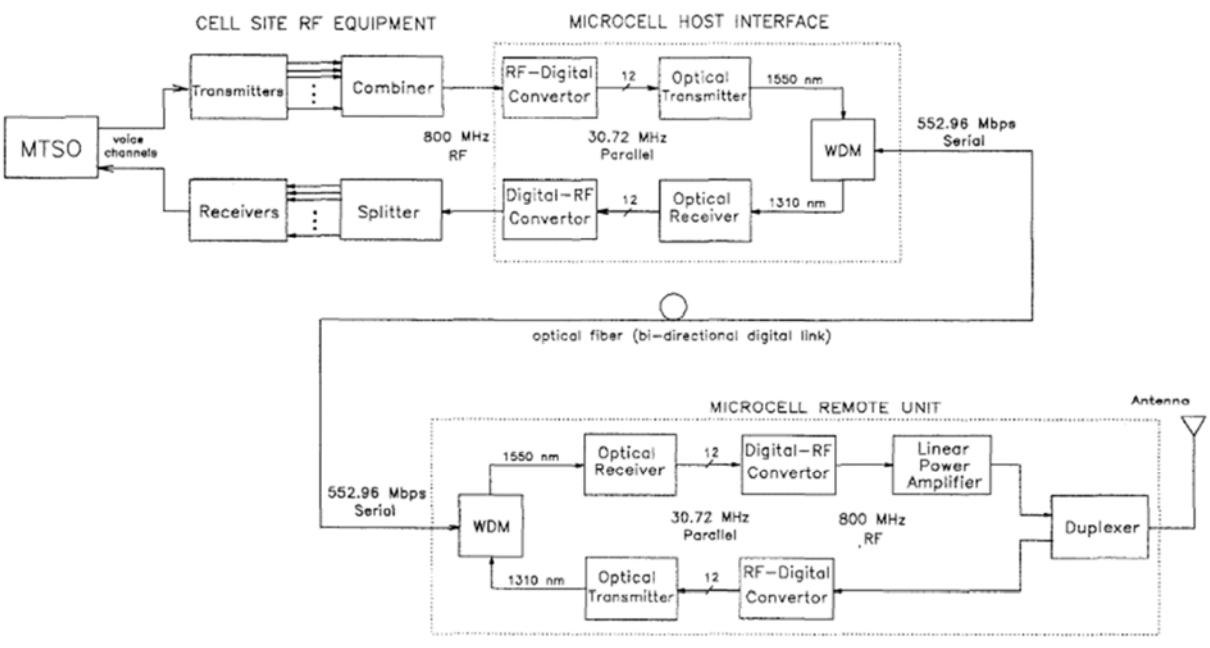


Fig.1. Digital RF transport microcell: system block diagram

While each of Oh and Wala provide sufficient detail for a POSITA to recreate their systems, each includes differing levels of detail on specific implementation details that could streamline system design and implementation. For example, Wala discloses specific sampling frequencies (*e.g.*, 30.72 MHz) used at its host and remote units, where Oh does not disclose example sampling rates. Wala also discloses example optical wavelengths (*e.g.*, 1310 nm, 1550nm) for its digital sample forwarding, where such wavelengths are not illustrated in Oh. Wala also discloses types of external networks (*e.g.*, a mobile telephone switching office (MTSO)) to which a digital RF transport system like Oh or Wala can be connected, where Oh does not explicitly identify that data source/designation.

Likewise, in certain areas where Wala provides limited detail, Oh provides additional example implementation details. For example, where Wala discloses only a high level RF-digital converter box, Oh discloses embodiments where received RF signals are downconverted to near DC before sampling on both the upstream and downstream sides. Oh discloses various mixers, filters, amplifiers, and frequency generators to implement downconversion operations (and corresponding operations for upconversions during RF signal recreation) that Wala omitted because such details would have been readily ascertainable or discoverable to a POSITA.

Thus a POSITA would have been motivated to combine Oh and Wala to have a more complete starting point for designing and implementing a digital RF transport system to extend RF coverage into hard to reach areas, as disclosed in both Oh and Wala. Ex. 1005, ¶¶239-242.

(b) Preamble and Elements 1-5

The preamble of claim 75 and elements 1-5 are analogous to the preamble and elements 1-4, 7 of claim 37. Those elements are rendered obvious for the reasons provided above in addressing claim 37. Ex. 1005, ¶243.

(c) Element 6: "wherein sample rates used by the host unit and the other units are locked together."

Oh discloses A/D conversion at 180 on the forward path in master unit (*e.g.*, forward master unit 100) and on the reverse path in the slave units 30 at 380.

FIG. 2

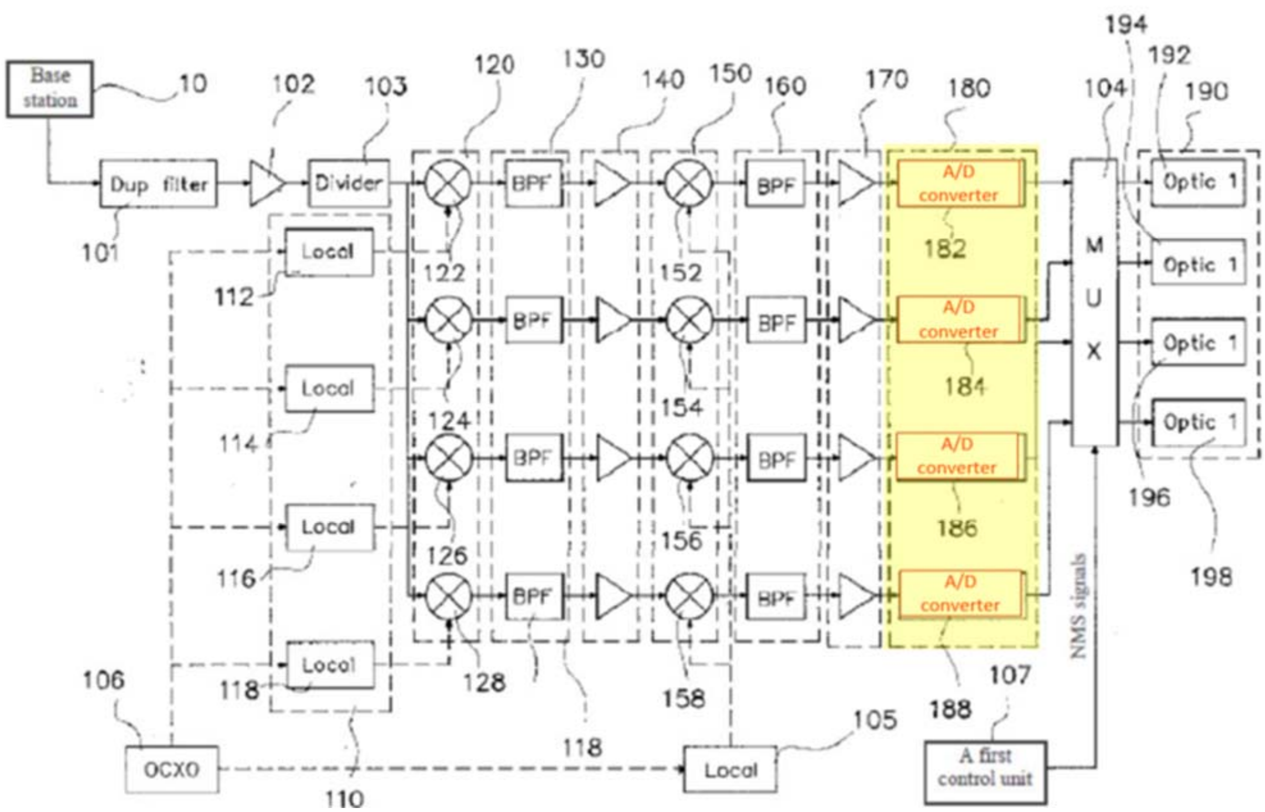
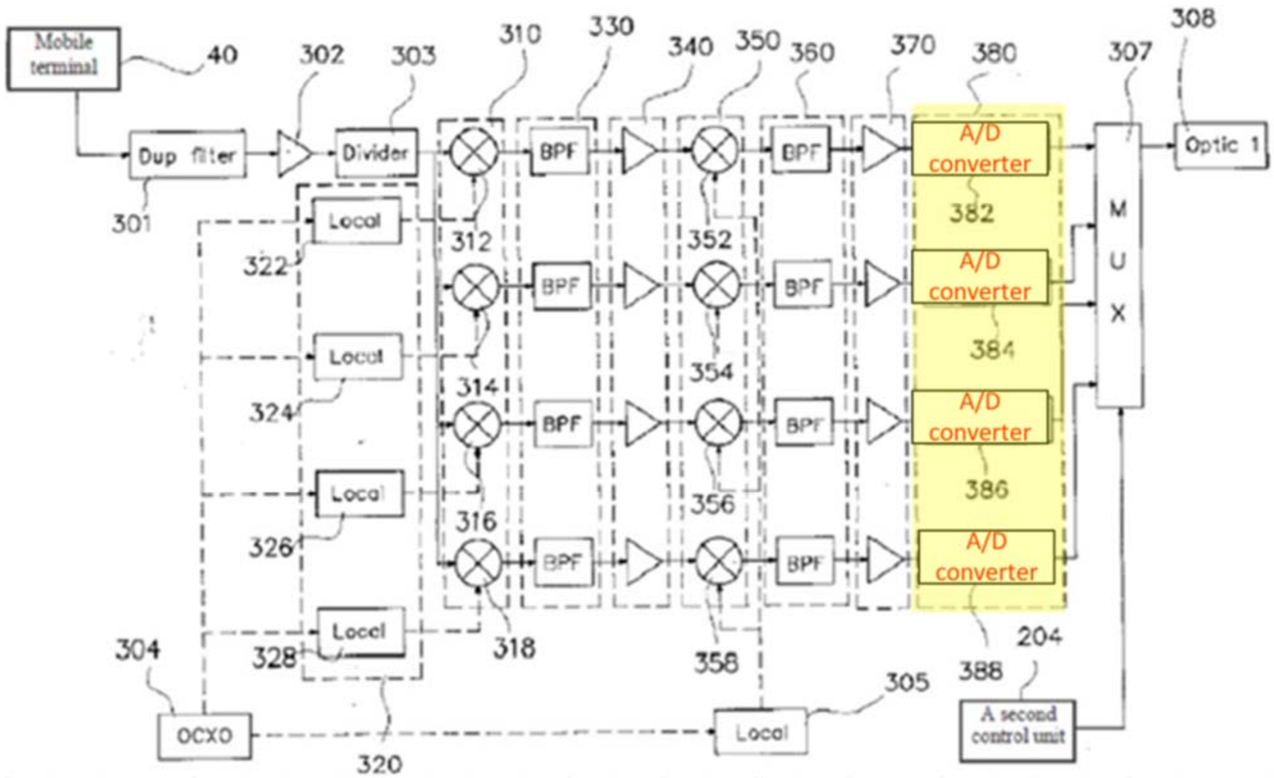


FIG. 4



To any extent that Oh does not explicitly or implicitly disclose that the sampling at 180, 380 (which is sampling analog wave forms in the same frequency ranges) is not providing that sampling at common, locked sampling rate, such locked rate sampling is rendered obvious by Oh in view of Wala. Wala discloses that its A/D sampling at both the host and remote units is performed at a common, locked 30.72 MHz.

Oh in view of Wala renders obvious wherein sample rates used by the host unit and the other units are locked together (*e.g.*, at 30.72 MHz).

Oh in view of Wala renders claim 75 obvious. Ex. 1005, ¶¶244-246.

2. Dependent Claims 76-77

The additional features of claims 76-77 are disclosed by Oh for the reasons noted above with reference to claims 40-41. Claims 76-77 are thus obvious based on Oh in view of Wala. Ex. 1005, ¶247.

3. Independent Claim 78

Independent claim 78 is analogous to independent claim 45. The only differences of substance are that claim 78 does not discuss the resolution of certain signals, but claim 78 does additionally recite that "sample rates used by the host unit and the other units are locked together."

The analogous elements of claim 78 are rendered obvious by Oh for the reasons provided above for claim 45. To any extent that Oh does not explicitly or implicitly disclose the locked sampling in the final element of claim 78, that feature is disclosed by Wala for the reasons discussed above in addressing the final limitation of claim 75.

Oh in view of Wala renders claim 78 obvious. Ex. 1005, ¶¶248-249.

4. Dependent Claims 79-80

The features of claims 79-80 are disclosed by Oh for the reasons above with reference to claims 40-41. Claims 79-80 are obvious based on Oh in view of Wala. Ex. 1005, ¶250.

Statement Regarding 35 U.S.C. § 314(a)

Petitioner presents two petitions here for the 81 claims of the '982 patent, with no more than 1 ground presented for each claim. It is respectfully submitted that both petitions be instituted based on the large number of claims of the '982 patent.

VI. Mandatory Notices Pursuant to 37 C.F.R. § 42.8(a)(1)

Pursuant to 37 C.F.R. § 42.8(a)(1), the mandatory notices identified in 37 C.F.R. § 42.8(b) are provided below as part of this petition.

A. 37 C.F.R. § 42.8(b)(1): Real Parties-In-Interest

SOLiD, Inc., SOLiD Gear, Inc., SOLiD Technologies, Inc., and SOLiD Gear Pte, Ltd. are the real parties-in-interest for Petitioner.

B. 37 C.F.R. § 42.8(b)(2): Related Matters

The ’982 patent was the subject of litigation in *CommScope Technologies LLC v. SOLiD Gear, Inc. et al.*, No. 3-20-cv-01285 (N.D. Tx.), filed on May 18, 2020. That litigation was dismissed without prejudice on January 6, 2021. IPR petitions for the remaining asserted patents of this litigation are being filed concurrently herewith. A second petition challenging claims of the ’982 patent that are not addressed in this petition is also filed concurrently.

The ’982 patent is also currently the subject of litigation in *CommScope Technologies LLC v. Dali Wireless Inc.*, No. 3-16-cv-00477 (N.D. Tx.), filed on February 1, 2016, now on appeal to the Federal Circuit in *CommScope Technologies LLC v. Dali Wireless Inc.*, 20-1817; -1818. Petitioner is uninvolved in that litigation.

CommScope Technologies LLC v SOLiD Technologies, Inc. High Court of Justice (Patents Court), Business and Property Courts of England & Wales, Claim number HP-2020-000017, is a further litigation involving the parties here.

C. 37 C.F.R. § 42.8(b)(3), (4): Lead And Back-Up Counsel And Service Information

Petitioner provides the following designation of counsel:

Lead Counsel	Back-up Counsel
Matthew W. Johnson (Reg. No. 59,108) JONES DAY 500 Grant Street, Suite 4500 Pittsburgh, PA 15219-2514 (412) 394-9524 mwjohnson@jonesday.com	S. Christian Platt (Reg. No. 46,998) JONES DAY 4655 Executive Drive, Suite 1500 San Diego, CA 92121-3134 (858) 314-1556 cplatt@jonesday.com Stephanie M. Mishaga (Reg. No. 75,378) JONES DAY 4655 Executive Drive, Suite 1500 San Diego, CA 92121-3134 (858) 703-3140 smishaga@jonesday.com Yeah-Sil Moon (Reg. No. 52,042) JONES DAY 250 Vesey Street New York, NY 10281-1047 (212) 326-3778 ymoon@jonesday.com David B. Cochran (Reg. No. 39,142) JONES DAY 901 Lakeside Ave. Cleveland, OH 44114 (216) 586-7029 dcochran@jonesday.com

Pursuant to 37 C.F.R. § 42.10(b), a Power of Attorney accompanies this petition.

Please address all correspondence to lead and back-up counsel at the addresses above.

Petitioner also consents to electronic service by email at the email addresses listed above.

Dated: August 12, 2021 Respectfully submitted,

/s/ Matthew W. Johnson

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that a copy of the foregoing petition for *Inter Partes* Review of U.S. Patent No. 7,639,982, including all Exhibits, was served on August 12, 2021 via Express Mail delivery directed to the attorney of record for the patent at the following address:

FOGG & POWERS LLC
4600 W 77th Street
Suite 305
MINNEAPOLIS MN 55435

Additionally, a courtesy copy of the foregoing petition for *Inter Partes* Review of U.S. Patent No. 7,639,982, and the accompanying Declaration of Dr. Jacob Baker, was sent on August 12, 2021 to CommScope's litigation counsel via email to the following addresses:

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shamer@carlsoncaspers.com
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Date: August 12, 2021

By: /s/ Matthew W. Johnson

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CERTIFICATE OF WORD COUNT UNDER 37 C.F.R. § 42.24(a)

I, the undersigned, do hereby certify that the attached petition contains 13,999 words, as measured by the Word Count function of Microsoft Word 2016. This is less than the limit of 14,000 words as specified by 37 C.F.R. § 42.24(a)(i).

Date: August 12, 2021

By: /s/ Matthew W. Johnson

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APPENDIX OF EXHIBITS

EXHIBIT NO.	TITLE
1001	U.S. Patent No. 7,639,982 ("'982 patent")
1002	U.S. Patent No. 8,326,218 ("'218 patent")
1003	U.S. Patent No. 8,577,286 ("'286 patent")
1004	U.S. Patent No. 9,332,402 ("'402 patent")
1005	Declaration of Dr. R. Jacob Baker
1006	'982 Patent File History
1007	Korean Laid-Open Disclosure No: KR1999-0064537 ("Oh")
1008	Acampora Report
1009	Philip M. Wala, "A New Microcell Architecture Using Digital Optical Transport," 1993 43rd IEEE Vehicular Technology Conference, 585 (1993) ("Wala")
1010	U.S. Patent No. 5,883,882 ("Schwartz")
1011	K. Ishida et al., "A 10-GHz 8-b multiplexer/demultiplexer chip set for the SONET STS-192 system," IEEE J. Solid-State Circuits, 1936 (1991) ("Ishida")
1012	Zygmunt Haas, "A Mode-Filtering Scheme for Improvement of the Bandwidth-Distance Product in Multimode Fiber Systems," J.

	Lightwave Tech., Vol. 11, No. 7, 1125 (1993) (“Haas”)
1013	U.S. Patent No. 5,379,455 (“Koschek”)
1014	U.S. Patent No. 5,631,757 (“Bodeep”)
1015	U.S. Patent No. 5,265,039 (“Curbelo”)
1016	’218 Patent File History
1017	’286 Patent File History
1018	’402 Patent File History
1019	U.S. Patent No. 5,774,789 (“van der Kaay”)
1020	U.S. Patent No. 5,606,736 (“Hasler”)
1021	U.S. Patent No. 6,496,546 (“Allpress”)
1022	U.S. Patent No. 5,969,837 (“Farber”)
1023	U.S. Patent No. 4,812,846 (“Noro”)
1024	CommScope Complaint
1025	U.S. Patent No. 4,779,064 (“Monser”)
1026	Declaration of Maria P. Garcia
1027	U.S. Patent No. 3,783,385 (“Dunn”)

1028	U.S. Patent No. 7,359,447 (“Sage”)