IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the *Inter Partes* Review of U.S. Patent No. 9,332,402

Trial No.:	Not Yet Assigned
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Filed:	October 15, 2013
Inventors:	Philip M. Wala
Assignee:	COMMSCOPE TECHNOLOGIES LLC
Title:	POINT-TO-MULTIPOINT DIGITAL RADIO FREQUENCY TRANSPORT

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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 1-57 of U.S. Patent No. 9,332,402 ("the '402 patent") (Ex. 1004).

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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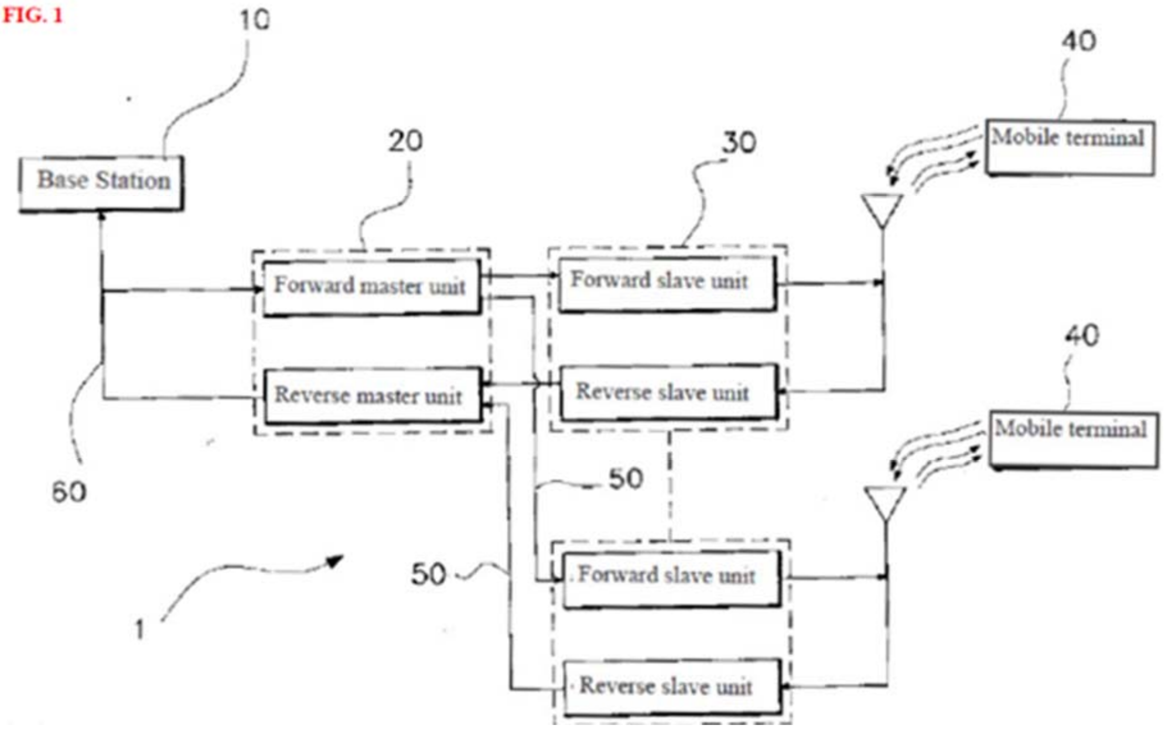
I. Introduction

U.S. Patent No. 9,332,402 (the ’402 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 ’402 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 ’402 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 ’402 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. 1004, claim 1. While the Examiner found the claims of the ’402 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.

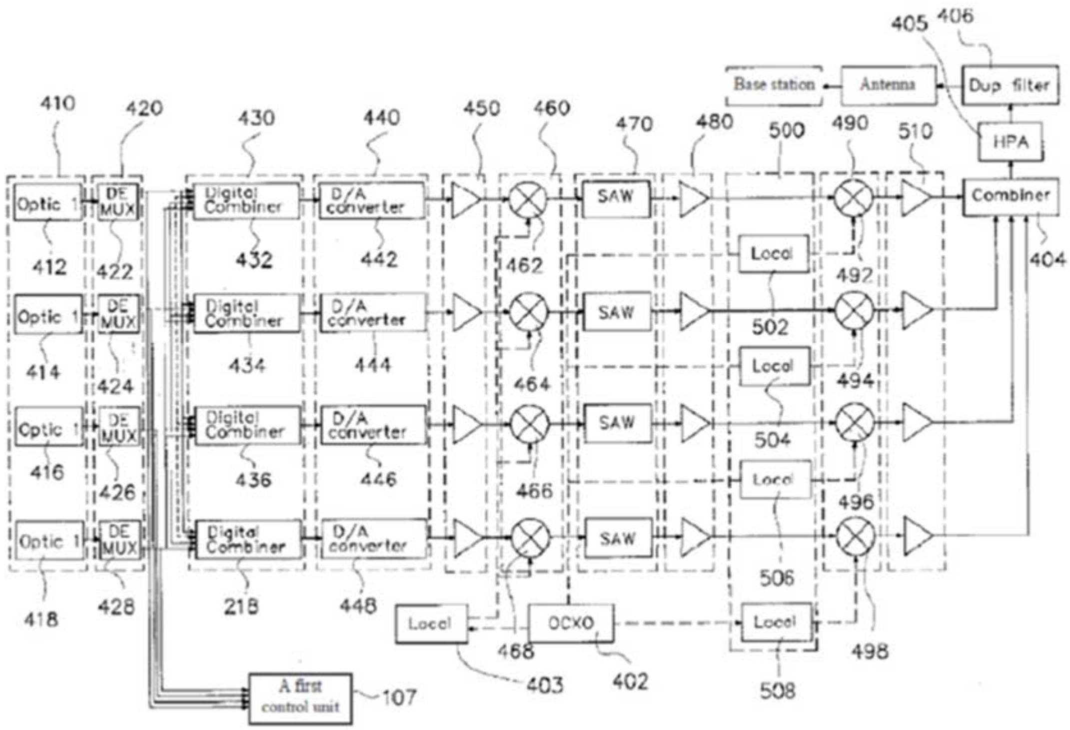
Oh clearly discloses the '402 patent's claimed systems and methods. Oh discloses a Digital Optic Repeater illustrated in Fig. 1 that helps extend RF signals to what it calls hard to reach "radio wave shadow areas." Ex. 1007, Abstract.

FIG. 1



And Oh discloses the host-based digital summing operation, where digital data is received at master unit 20 at 412, 414, 416, and 418 from multiple remote slave units 30 and is routed to digital combiners 432, 434, 436, 438 on which an analog RF signal is created for transmission to the base station. *See*, Ex. 1007, 5:14-17 ("Four intermediate frequency signals in the same frequency band outputted from each demultiplexer are transmitted to one digital combiner. After creating 14-bit intermediate frequency signals by <u>combining four 12-bit intermediate frequency signals</u> in the same frequency band,…")

FIG. 5



Had the Examiner had access to the Oh reference during prosecution, the ’402 patent would not have issued. Because claims 1-57 are unpatentable as described herein, institution of trial for *Inter Partes* Review is requested to consider cancellation of the challenged claims. Ex. 1005, ¶¶31-58, 70-75.

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

The ’402 patent is expired but remains in the time period during which it may be asserted under 35 U.S.C. § 286. Petitioner certifies the ’402 patent is available for IPR and Petitioner is not barred or estopped from requesting IPR challenging the patent claims on the grounds identified herein.

III. Background Information For The ’402 Patent

A. Overview Of The ’402 Patent

The ’402 patent is directed to a digital distributed antenna system illustrated in Fig. 1 having a host unit and multiple distributed remote antenna units.

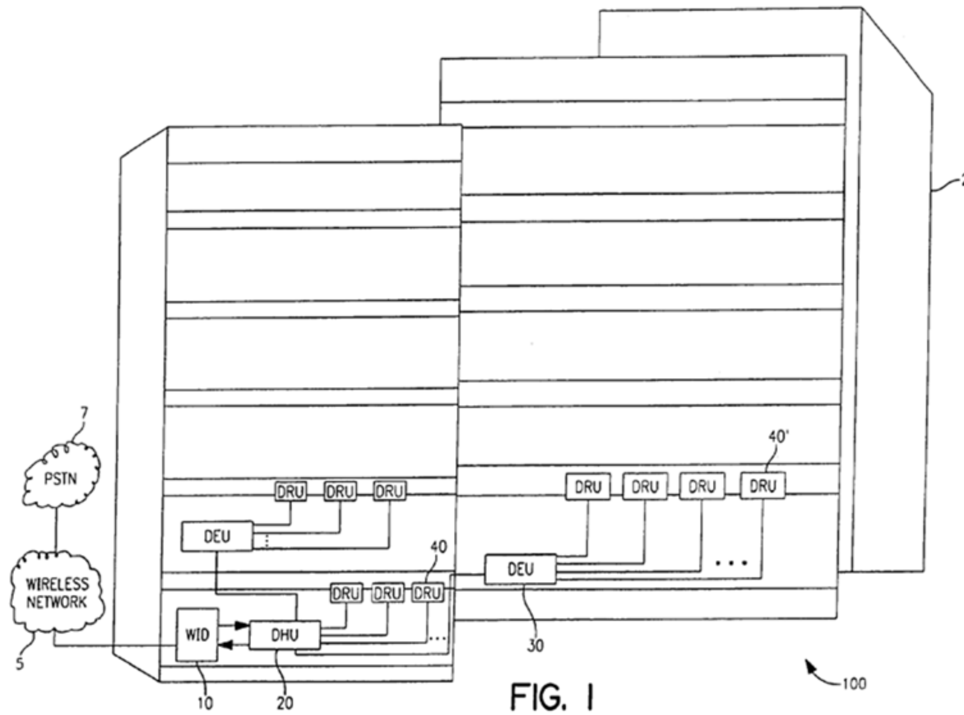
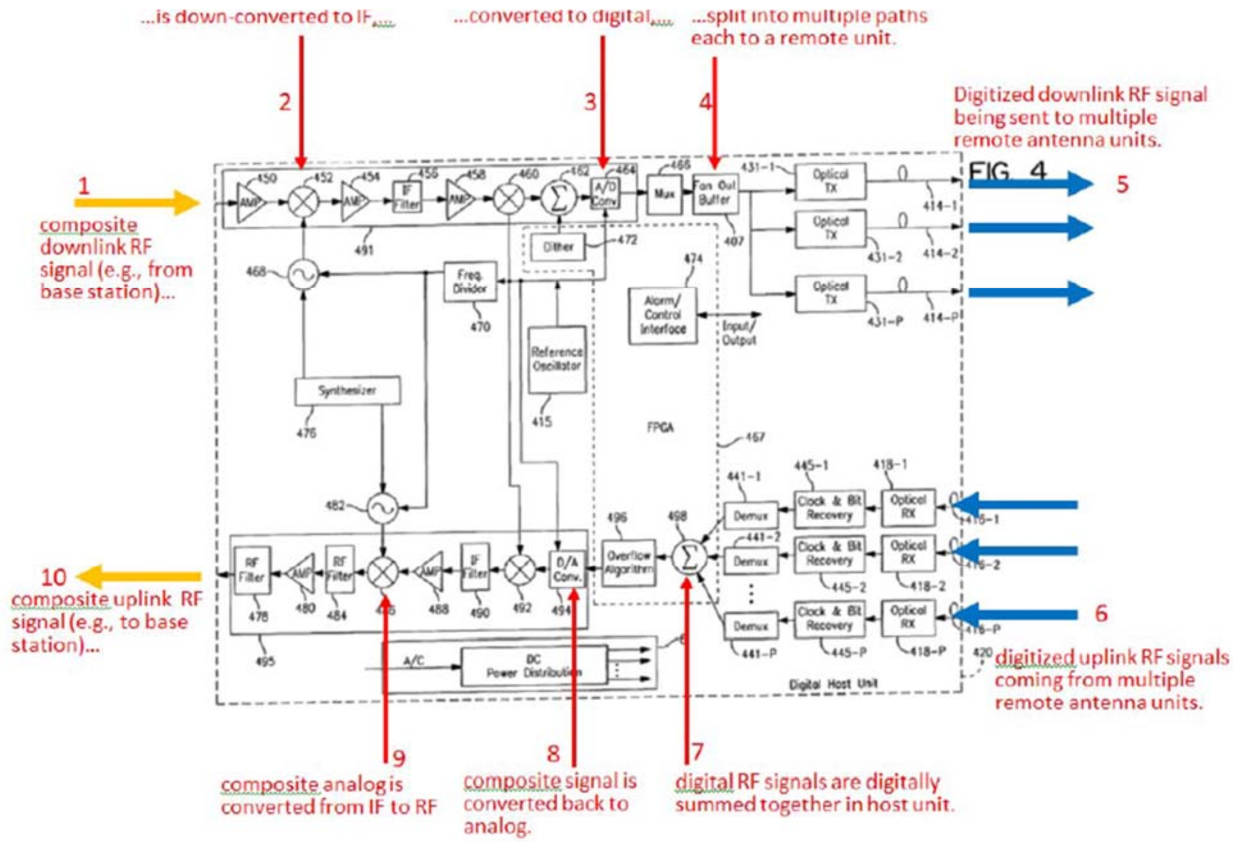


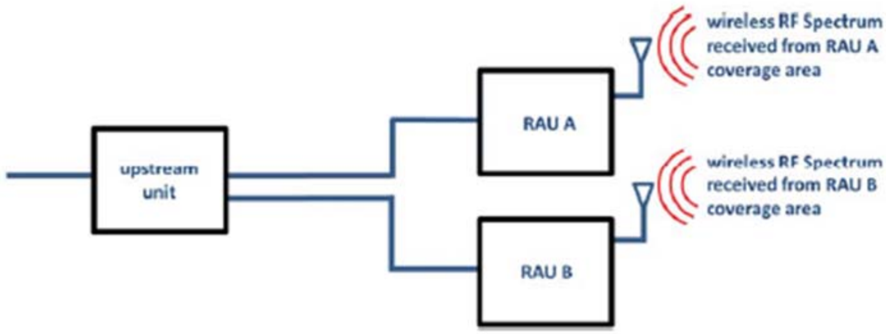
FIG. 1

Annotated Fig. 4 of the ’402 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 further 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).

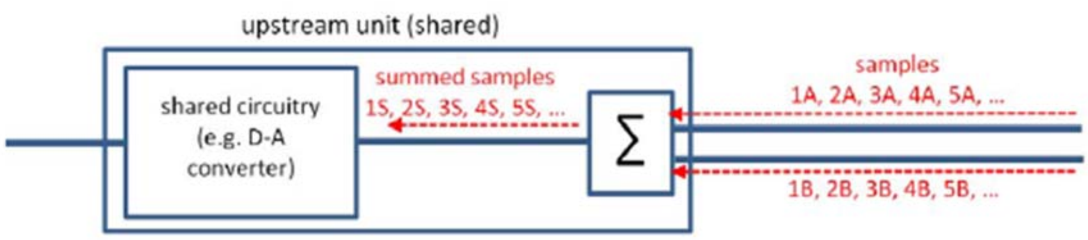


In the downlink direction, the host unit down-converts a composite downlink RF signal, takes a sequence of digitized samples, and delivers a sequence of digitized samples over a fiber optic cable to each of several remote units. Ex. 1004, 7:14-28. At each digital remote unit, the arriving stream of digital samples are converted back into the analog signal from which they are derived and then delivered to an antenna for transmission. *Id*., 9:17-32.

In the uplink direction, each digital 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. 1004, 9:46-50 (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. 1004, 7:64-8:19; 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 '402 patent issued after a single Office Action having only a double patenting rejection. The '402 patent was allowed after filing of a terminal disclaimer.

Ex. 1018, 132, 119. Oh was not considered by the Examiner during prosecution of the '402 patent.

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 '402 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 1-57 of the '402 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 Yong Hoon Oh ("Oh") (Ex. 1007). Oh is prior art to the '402 patent at least under 35 U.S.C. §102(a).
- U.S. Patent No. 5,883,882 to Adam Schwartz ("Schwartz"). Schwartz is prior art to the '402 patent under at least 35 U.S.C. §§ 102(a), (b), and (e).

- U.S. Patent No. 6,496,546 to Stephen Alan Allpress ("Allpress"). Allpress is prior art to the '402 patent under at least 35 U.S.C. § 102(e).

- U.S. Patent No. 5,969,837 to Allan Farber ("Farber"). Farber is prior art to the '402 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, 2, 5-7, 10-21, 24, 25, 27-32, 35-44, 47, 48, 51, 52, 55, and 56 are unpatentable under 35 U.S.C. § 103 over Oh;

Ground 1b: Claims 3, 4, 22, 23, 33, 34, 45, 46, 53, and 54 are unpatentable under 35 U.S.C. § 103 over Oh in view of Schwartz; and

Ground 1c: Claims 8, 9, 26, 49, 50, and 57 are unpatentable under 35 U.S.C. § 103 over Oh in view of Allpress.

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). Petitioner proposes no claim terms for construction at this time.

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

An explanation of how claims 1-57 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 Claims 1-57 Of The '402 Patent Are Unpatentable

A. Brief Overview Of The Prior Art

1. Overview Of Oh

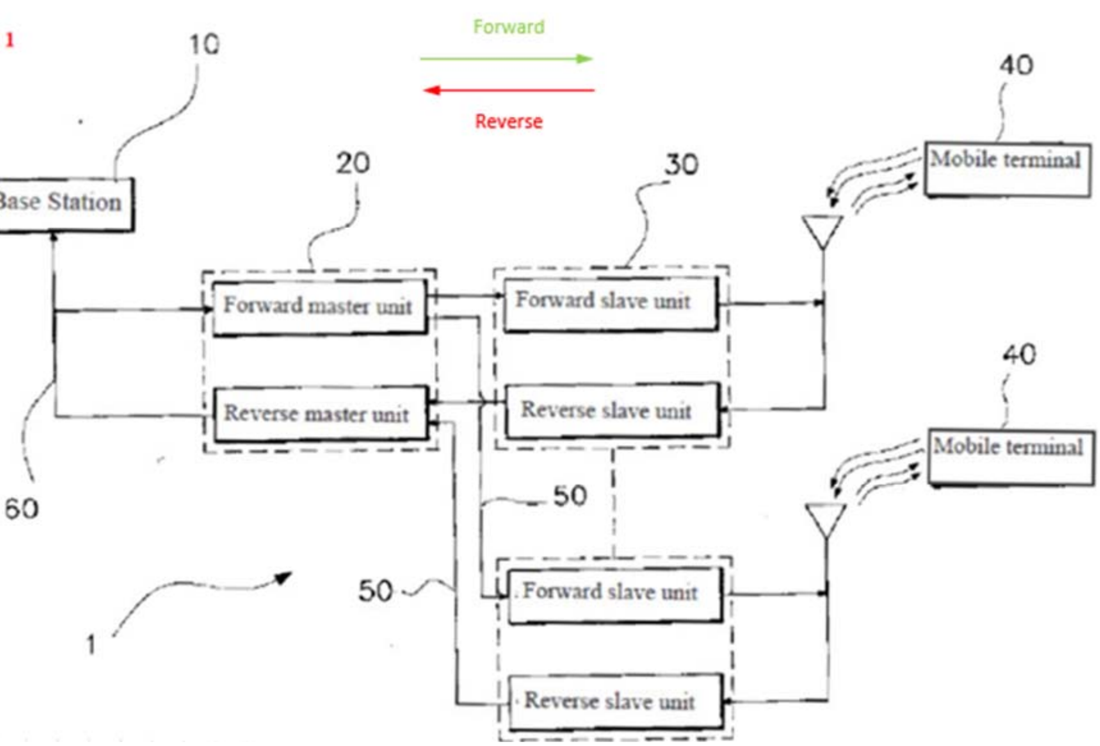
Oh is a publication of a Korean patent application filed by Yong Hoon Oh on April 3, 1999. Oh was published on August 5, 1999.

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 optic 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")

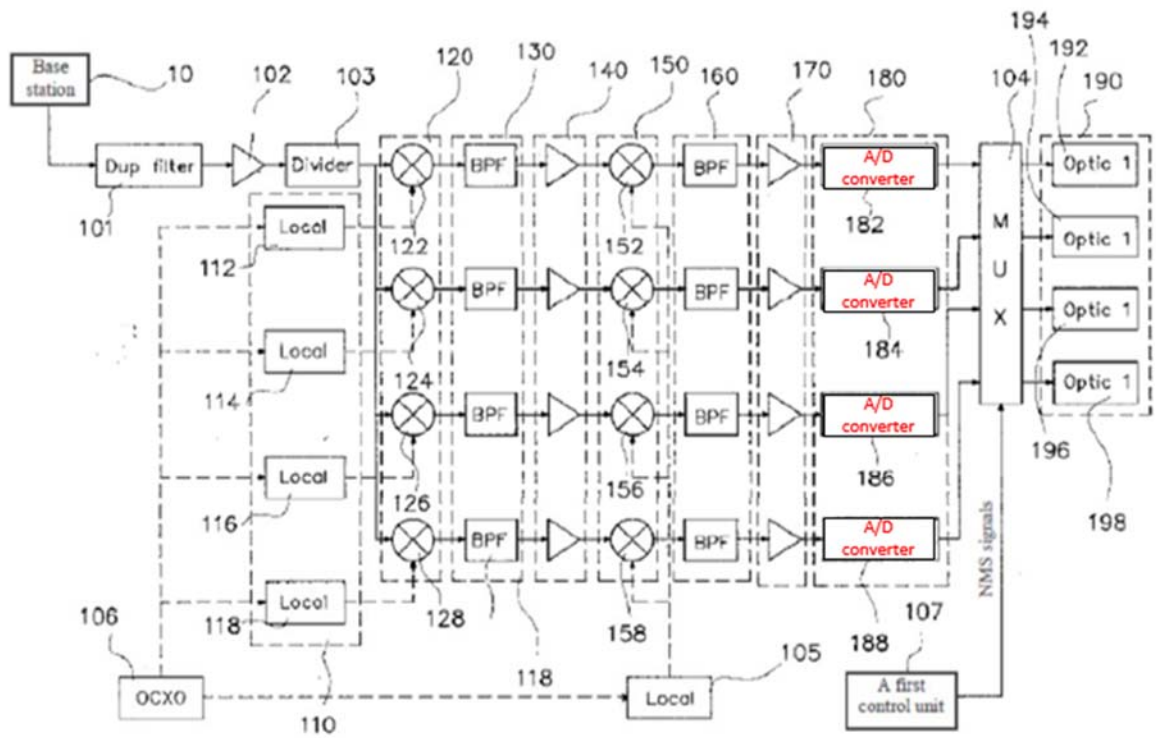


Fig. 2 provides example detail of the forward portion of Oh's master unit 20. The forward master unit receives RF signals from the base station 10 through a bi-directional filter 101. A divider 103 divides the RF signals into its component frequency bands (*i.e.*, the component frequency bands that make 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

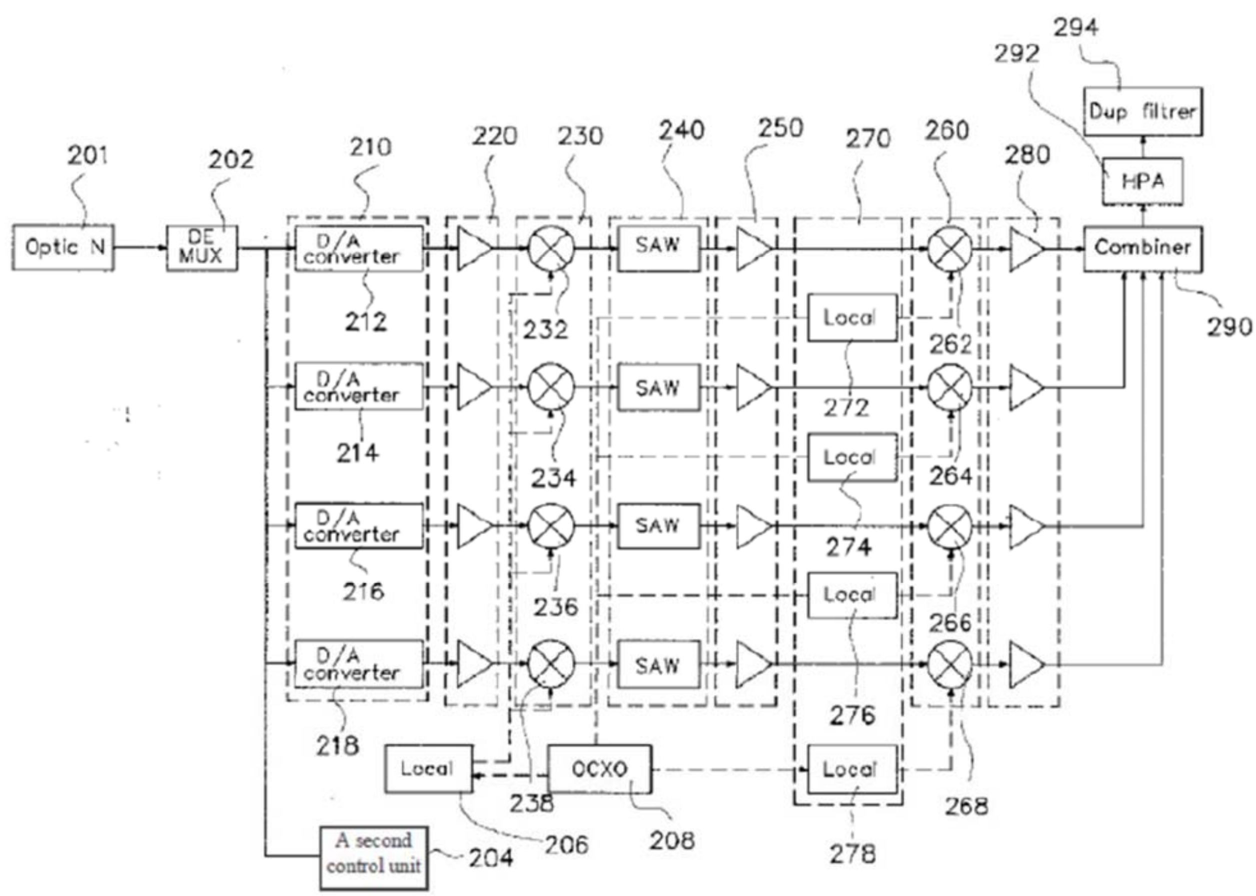


Fig. 3 provides example detail of the forward portion of one of Oh's slave units 30. The 52-bit digital signal transmitted on one of the optic lines 50 is received at a second optic converter unit 201. The 4 bits of control data are provided to control unit 204. Each of the 12-bit sample signals is routed to a respective digital to analog (D/A) converter 212, 214, 216, 218 at the start of respective paths for recreating the RF signal received from the base station *Id.*, 3:62-25. Each D/A converter converts its 12-bit digital signals to intermediate frequency signals, which are amplified at 220, mixed with a step up frequency at 230, amplified again at 250, mixed with a respective frequency at 260 to recreate the analog band frequency signals, and amplified again at 280. *Id.*, 3:50-59. "[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." *Id.*, 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")

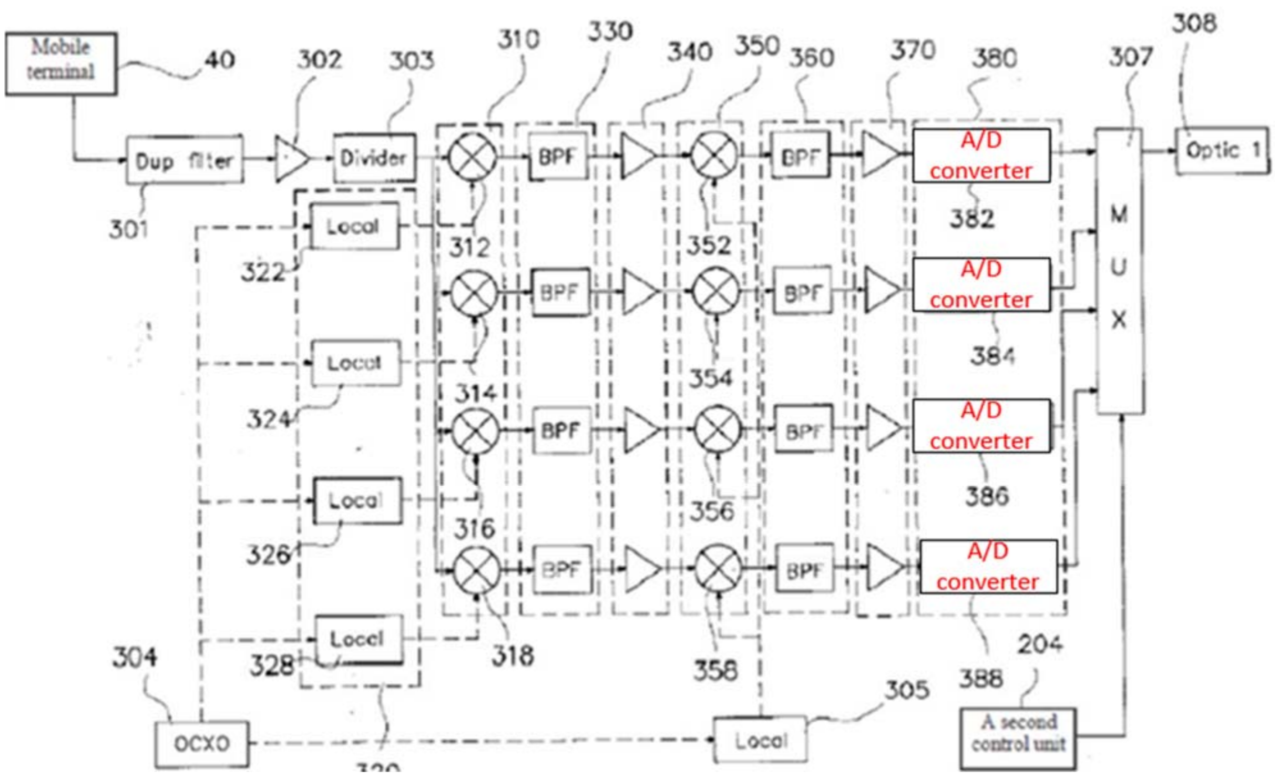


Fig. 4 illustrates example details of the reverse path at a slave unit 30 (*e.g.*, reverse slave unit 300). "RF signals transmitted from the mobile terminals 40 of the reverse slave unit 300 of the slave unit 30 through the antenna are converted to the intermediate frequency signals close to DC…, mixed 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. RF signals from the mobile terminals 40 are directed through a bi-directional filter 301 to a divider 303. Similar to the master unit divider of Fig. 2, the divider 303 divides the RF signal from the mobile terminals 40 into component frequency bands, where each of those component band signals is processed in parallel through mixer unit 310, BPF 330, amplifier 340, mixer unit 350, BPF 360, and amplifier 370 collectively to transition the signals from their band frequencies to baseband frequency close to DC. *Id.*, 4:26-34. A/D converters 382, 384, 386, 388 sample the baseband signals to convert them to digital representations of the analog component frequency band signals. *Id.*, 3:14-16. Multiplexer 307 multiplexes the four 12-bit digital sample values with 4-bit NMS control data from control unit 204 and applies that 52-bit serial data stream to optic converter 308 for transmission across optic line 50 to master unit 20. *Id.*, 3:56-61.

FIG. 5

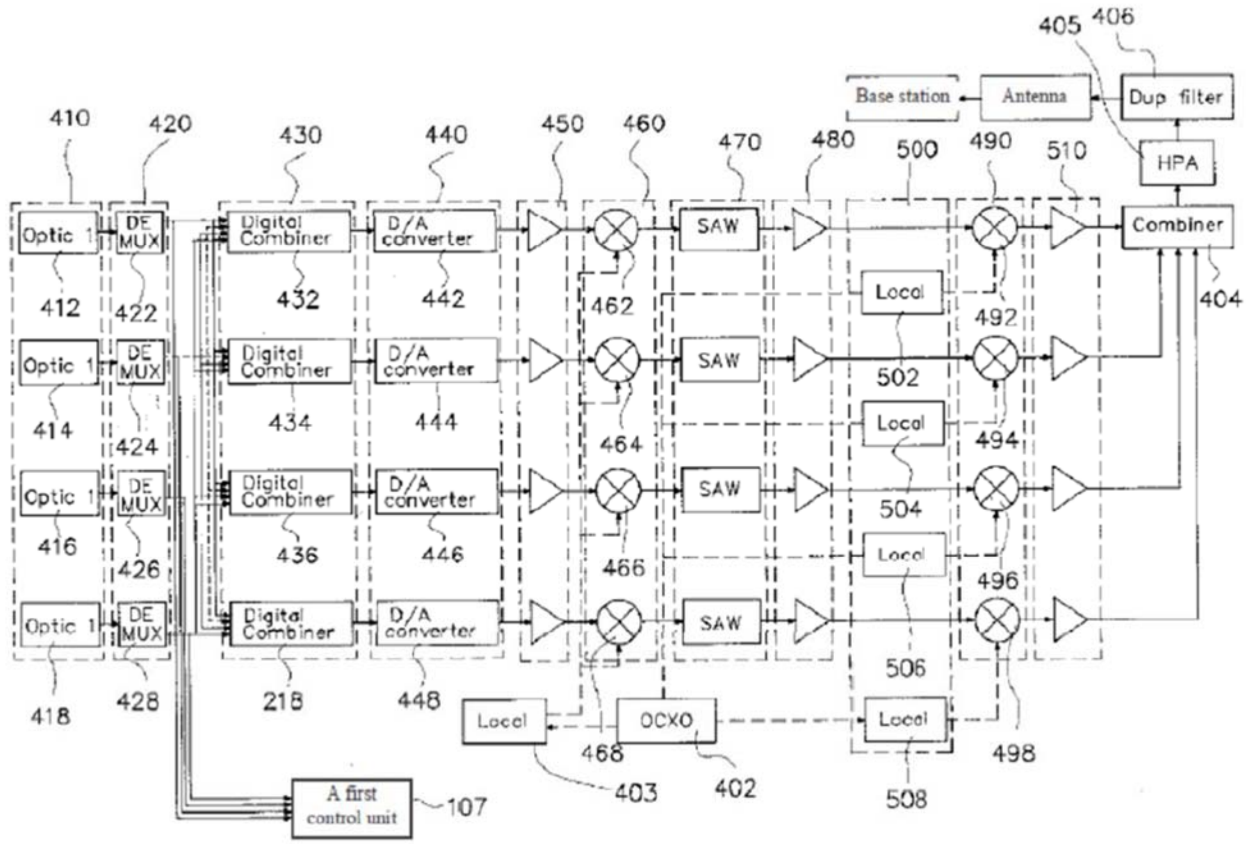


Fig. 5 illustrates example detail of the reverse path at the master unit 20 (*e.g.*, reverse master unit 400), which receives four streams of digital data from four slave units over optic lines 50 (*i.e.*, digital data from a first slave unit at 412, a second slave unit at 414, a third at 416, and a 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. *Id.*, 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.

The similarities between Oh's implementation and the specification examples of the '402 patent are striking. The only differences of arguable import are the lack of explicit disclosure of expansion units in Oh (addressed by the Schwartz obviousness combination detailed in the companion IPR petition addressing '402 patent claims), and the fact that Oh divides and then digitizes and reconstructs its analog signals on a per frequency band basis (notice four rows of processing in each of Oh's Figs. 2-5), while the '402 patent performs a single digitization of its entire received analog signals.

This difference is a matter of design choice and is of little technical import, and more importantly is irrelevant to the claims. Whether one samples an entirety of a received analog signal for optical transmission and subsequent analog recreation at once, or one divides the received analog signal into its component bands before sampling, transporting, recreating those bands and combining them (*e.g.*, at combiner 404), the resulting analog signal at the destination carries the same information. And most importantly, when the claims discuss digitizing an analog signal, there are no recited requirements about how that analog signal is represented by the digital data (*i.e.*, there are no requirements regarding whether the digital data represents only a single analog wave form, rather than representing its (4) component bands that when combined form the analog waveform). Thus Oh's difference in implementation choice is irrelevant to the unpatentability analysis for this matter.[1]

Oh is analogous art to the '402 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.

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[1] Further, the number of bands that Oh processes is configurable (*see*, 3:9 ("*e.g.*, 4 ea.")). In the nominal case where Oh operates on only a single frequency band channel, Oh's operation (*i.e.*, a single sampling/reconstruction path representing the entire received analog signal) is almost identical to that of the '402 patent.

2. Overview Of Schwartz

Like the ’402 patent and Oh, Schwartz addresses expansion of RF signal coverage into hard to reach areas “especially within structures or around other obstacles, man-made or natural, which otherwise tend to block or disrupt radio waves.” Ex. 1010, 1:26-30. Schwartz proposes a radio frequency transport system similar to the ’402 patent and Oh, differing in that Schwartz propagates signals from its host unit (central station 20) to its remote units (remote stations 22) using analog signals. Oh recognized such analog RF distribution systems as state of the art prior to its invention of its digital relays. *See*, Ex. 1007, 2:28-30 (Conventional Technology – “Since the RF signals transmitted/received to/from said first optic repeater and a second optic repeater are analog signals, the strength of the signals is greatly decreased during transmission through the optical line.”)

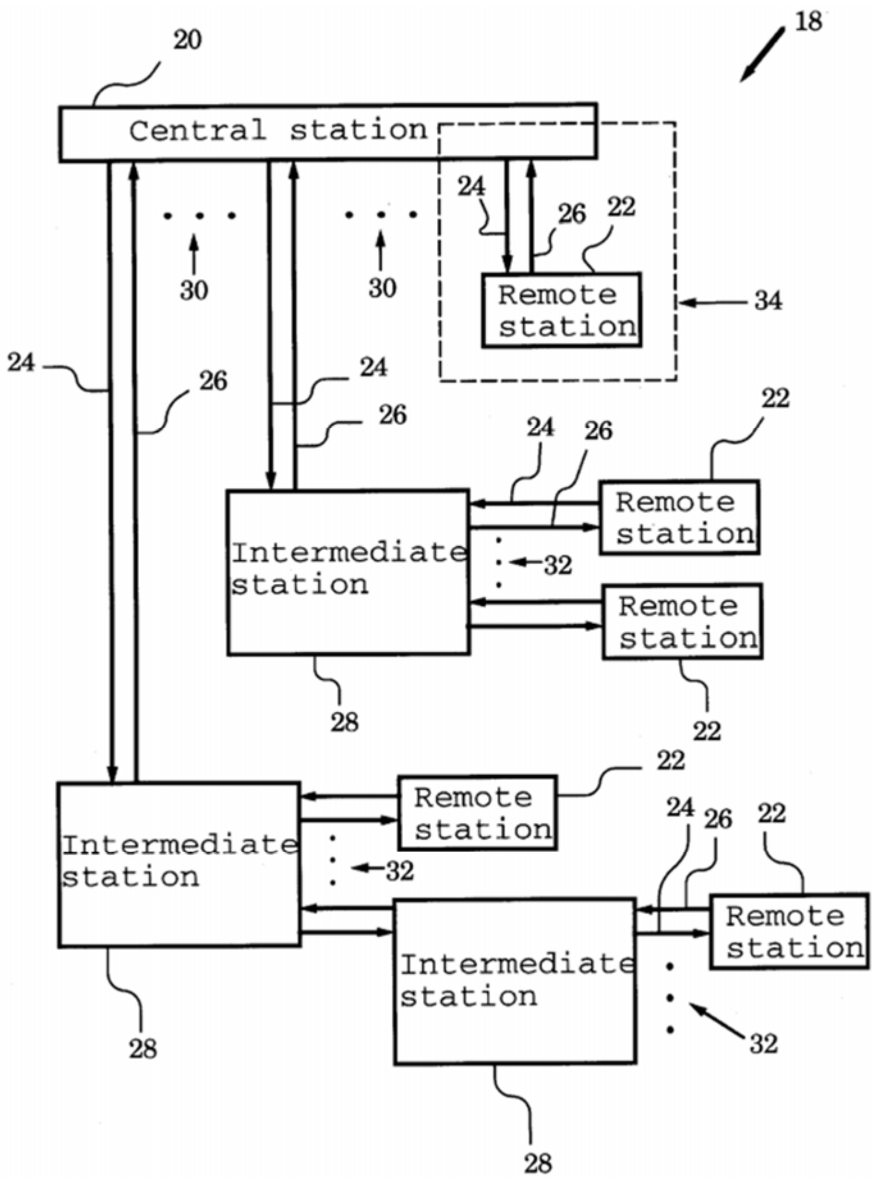


FIG. 1

While Schwartz discloses an analog RF signal distribution platform, the likes of which Oh improved upon via its relay digitization, Schwartz evidences that it was well known to implement RF signal distribution systems using topologies beyond the host↔remote unit arrangement of Oh. Schwartz, like Oh discloses implementations where some branches may contain remote units directly connected to the host unit, as illustrated at 34. Ex. 1010, 42-44.

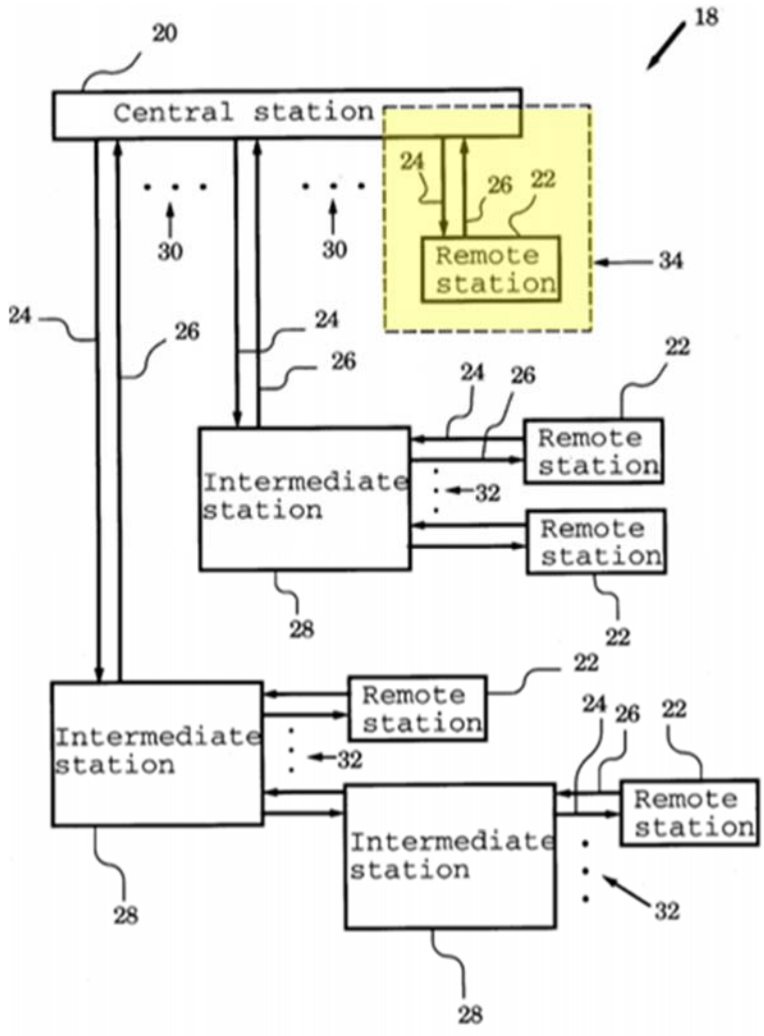


FIG. 1

Schwartz also discloses additional branches whereby intermediate stations 28 may be connected to the host central station 20, and even to other intermediate stations 28, so as to expand the number of remote stations 22 to which the central station is ultimately responsive.

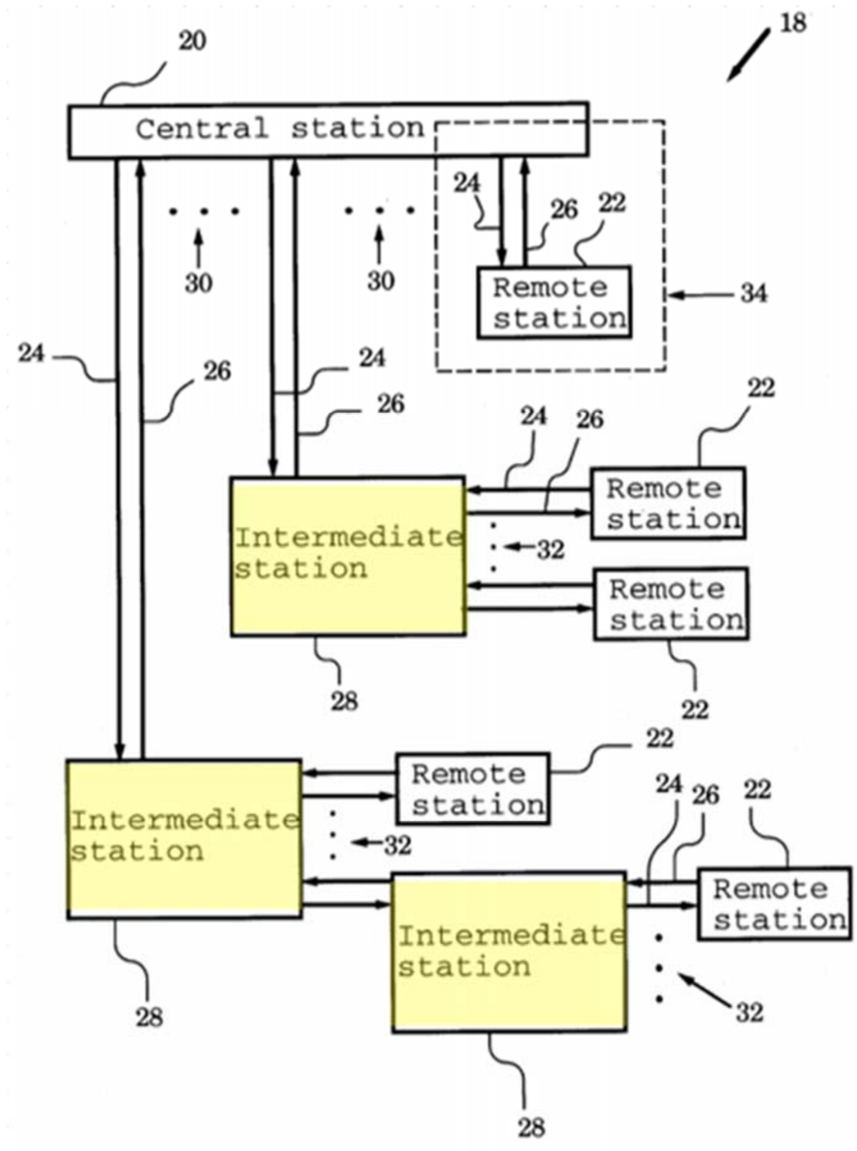


FIG. 1

Ex. 1010, 4:38-42 ("Intermediate stations 28, preferably are repeaters and likewise have pairs of downlink cable 24 and uplink cable 26 which in turn connect to any number of other intermediate stations 28 and/or remote stations 22.")

Schwartz's intermediate stations 28 "preferably are repeaters" (4:38-39), where example intermediate station 28 implementation details are shown in Fig. 7a. Ex. 1010, 10:13-15.

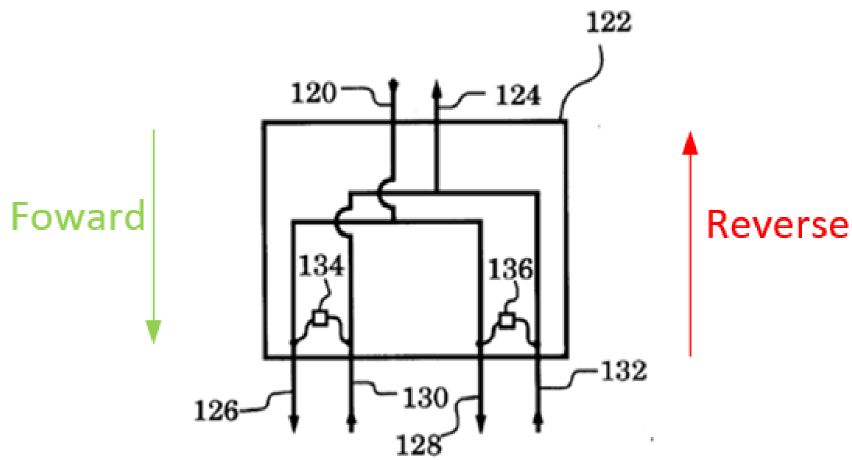


FIG. 7a

In the forward direction (top to bottom in the figure), "downlink connection 120 splits into two secondary downlink connections 126 and 128 before exiting station 122." Ex. 1010, 10:15-18. In the reverse direction (bottom to top in the figure), "uplink connection 124 is fed by two secondary uplink connections 130 and 132." *Id.*, 10:19-20. In that uplink operation, signals from downstream units (*e.g.*, remote units) are received at 130, 132 and applied to a common uplink connection line 124, aggregating the analog signals received on those lines. Ex. 1005, ¶91.

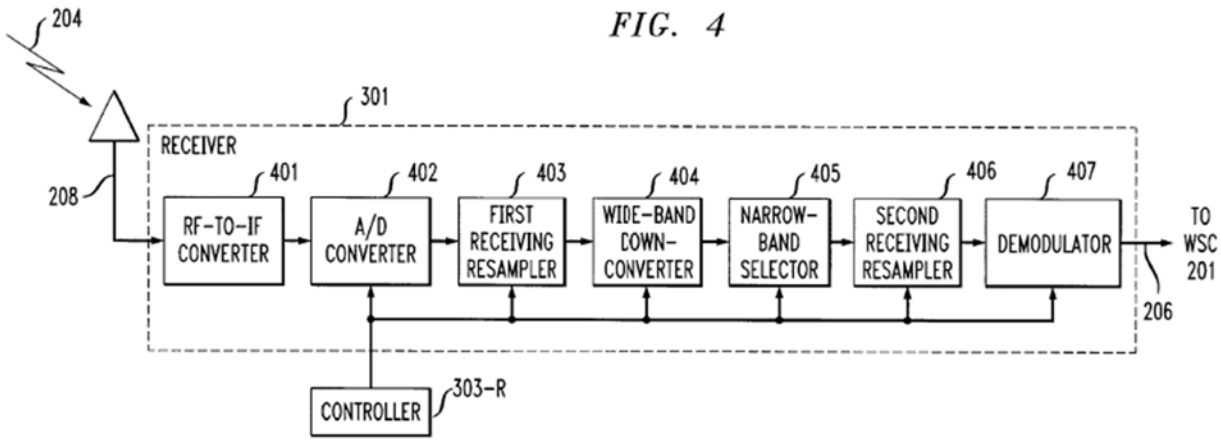
Schwartz's RF signal distribution topology that supports intermediate expansion units enables a network where host central station 20 is connected to "any number of intermediate stations 28 and/or remote stations 22," providing an RF signal distribution platform that is customizable to the difficult RF environment into which the platform is installed. Ex. 1010, 4:34-38; 1:24-30 ("[I]ntermediate stations provide bi-directional branching points within the network. Such a system is highly advantageous for providing wireless two-way communication service especially within structures or around other obstacles, man-made or natural, which otherwise tend to block or disrupt radio waves.”). Ex. 1005, ¶¶89-92.

3. Overview of Allpress

Allpress is a U.S. Patent filed in July 1998 entitled “Software-Defined Transceiver for a Wireless Telecommunications System,” that describes techniques for receiving and transmitting wireless telecommunications using a software-defined transceiver. Ex. 1021, Abstract. Allpress states that software transceivers can avoid the need for “duplicative hardware.” Allpress further states that its “generic architecture” is not “standard specific” and thus can be easily ported to different implementations without modification, a benefit that would not be possible with a hardware implementation with hardwired physical components. Ex. 1021, 2:5-50. Allpress states that its software transceivers may be implemented in a variety of locations such as “in a base station or at a location other than a base station,” including locations that communicate with base stations. *Id*., 3:46-48.

Fig. 4 depicts a software-based RF receiver, and Fig. 7 depicts a software-based RF transmitter.

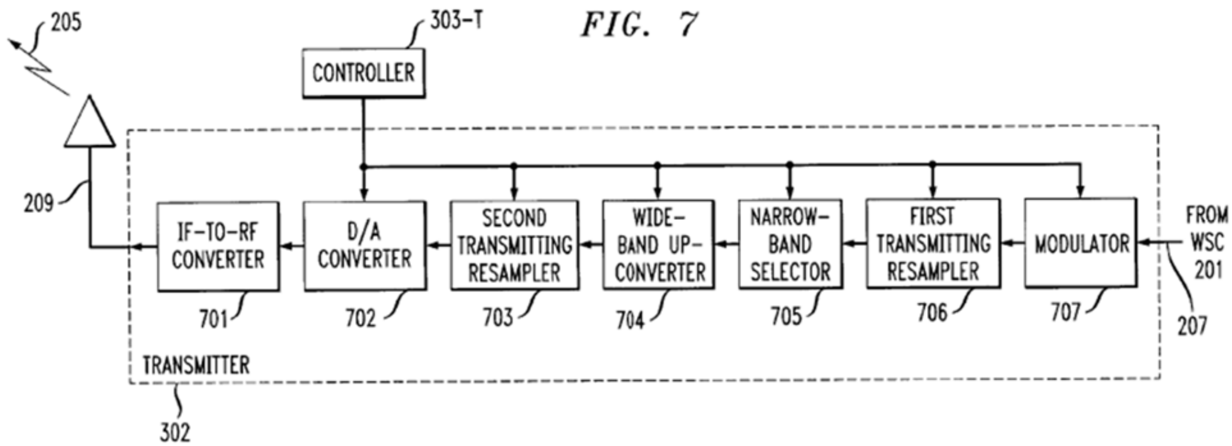
FIG. 4



Allpress describes its receiver stating:

> FIG. 4 depicts a schematic diagram of a portion of receiver 301 of the illustrative embodiment of the present invention, which comprises RF-to-IF converter 401, analog to-digital converter 402, first receiving resampler 403, wide band down-converter 404, narrow-band selector 405, second receiving resampler 406, demodulator 407 and controller 303-R, interconnected as shown. First receiving resampler 403, wide-band down-converter 404, narrow-band selector 405, and second receiving resampler 406 <u>are software-defined devices</u>.

Ex. 1021, 4:43-53.



Allpress further describes its transmitter stating:

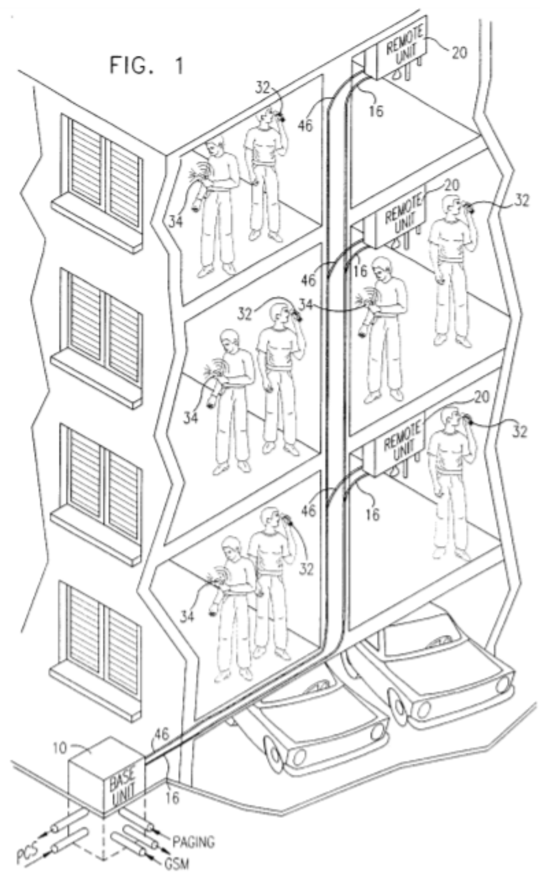
> As depicted in FIG. 7 transmitter 302 comprises IF-to-RF converter 701, digital-to-analog converter 702, second transmitting resampler 703, wide-band up-converter 704, narrow-band selector 705, first transmitting resampler 706, modulator 707 and controller 303-T, interrelated as shown. For illustrative purposes controller 303-T, which controls transmitter 302, and controller 303-R, which controls receiver 301, are depicted as separate devices. It should be understood, however, that a single controller can be used to control both the receiving and transmitting sections. Second transmitting resampler 703, wide-band up-converter 704, narrow-band selector 705, and first transmitting resampler 706 are software-defined devices.

Ex. 1005, ¶¶96-97; Ex. 1021, 8:30-42.

4. Overview of Farber

Farber is a U.S. Patent filed in July 1997 entitled "Communications System," that 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.



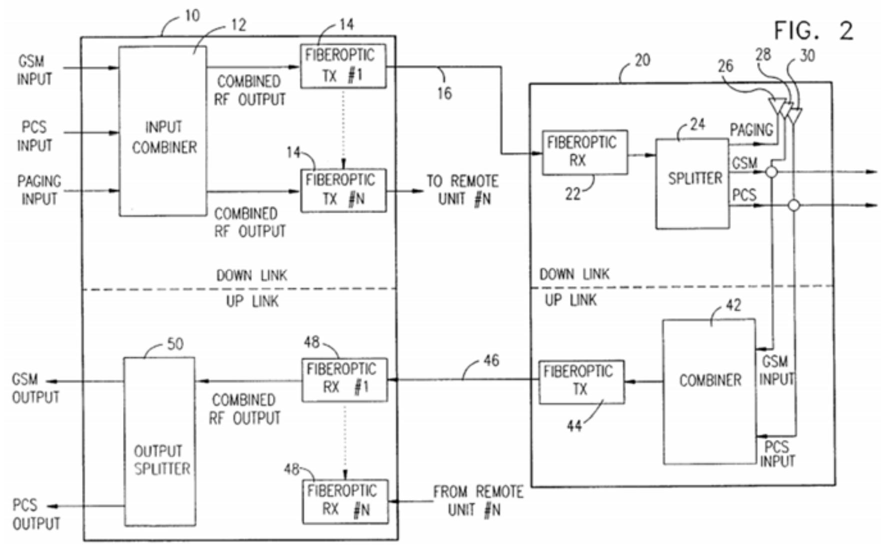


FIG. 2

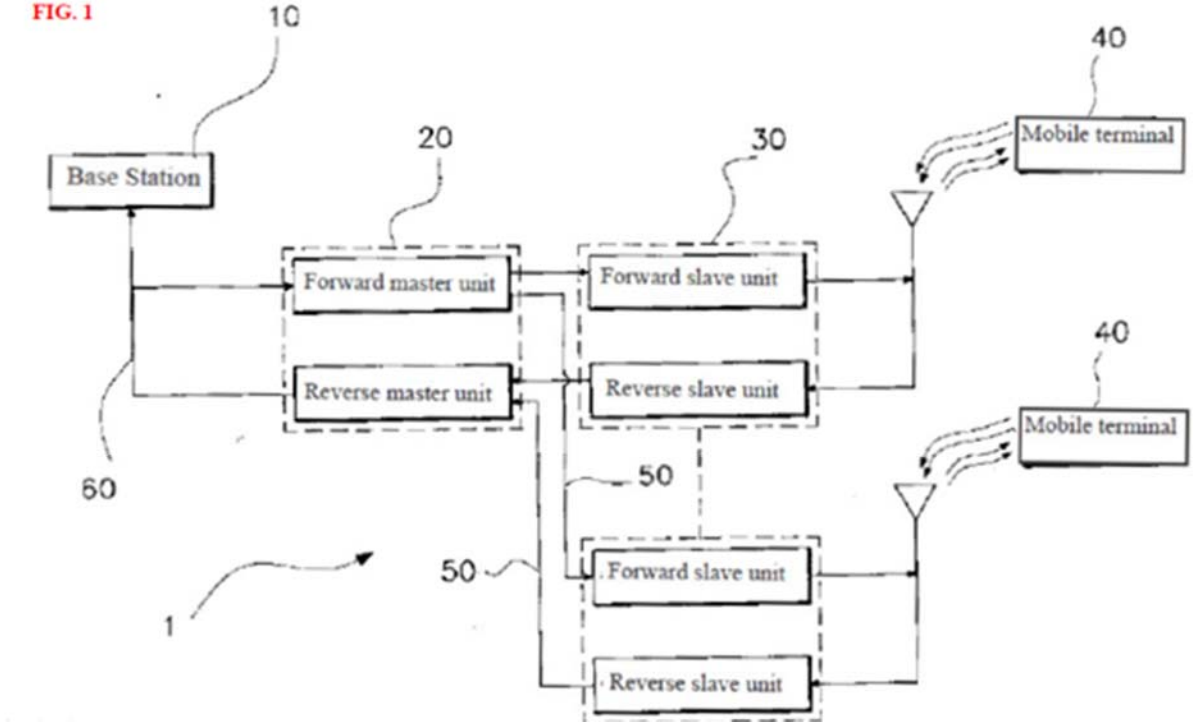
B. Ground 1a: Claims 1-2, 5-7, 10-21, 24, 25, 27-32, 35-44, 47, 48, 51, 52, 55, and 56 Are Obvious Over Oh

1. Independent Claim 1

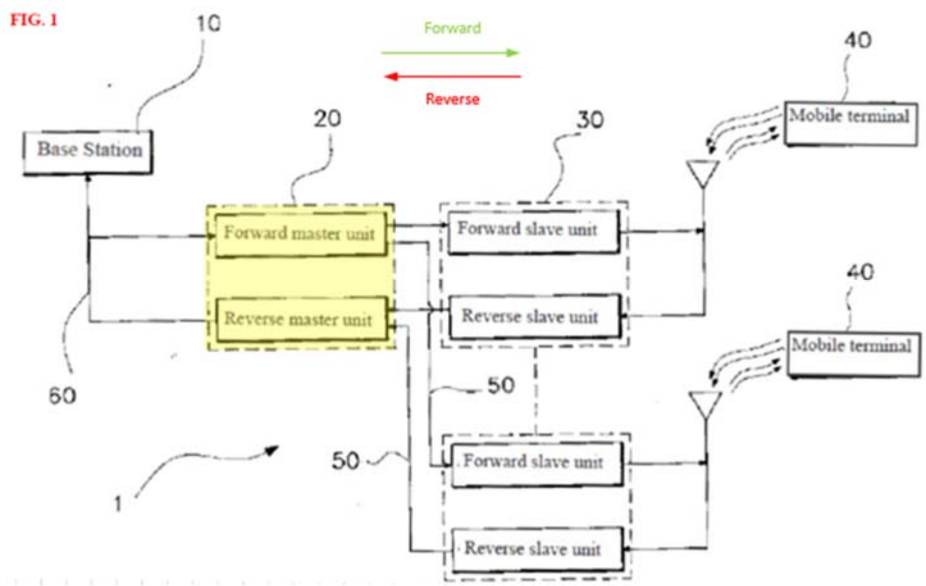
(a) Preamble and Elements 1 and 2: "A system for digital transport of a wireless spectrum, the system comprising: a first unit; and a plurality of second units communicatively coupled to the first unit using at least one wired communication link and remotely located from the first unit;"

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 (*e.g.*, at 800 MHz, 1800MHz)). *Id.*, Abstract, Fig. 1, 3:19, 4:40. Fig. 5 of Oh illustrates the communications between master unit 20 and the base station 10 may be wireless communications via an antenna.

FIG. 1



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. *Id.*, 2:70-3:1; 4:62-64.



Oh's master unit 20 is analogous to the '402 patent's digital host unit (DHU) 20 which interfaces with a wireless interface device (WID) 10 that in embodiments comprises a base station (Ex. 1004, 4:37-38). And like Oh's master unit 20, on the forward path the '402 patent's 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.*, 4:48-51.

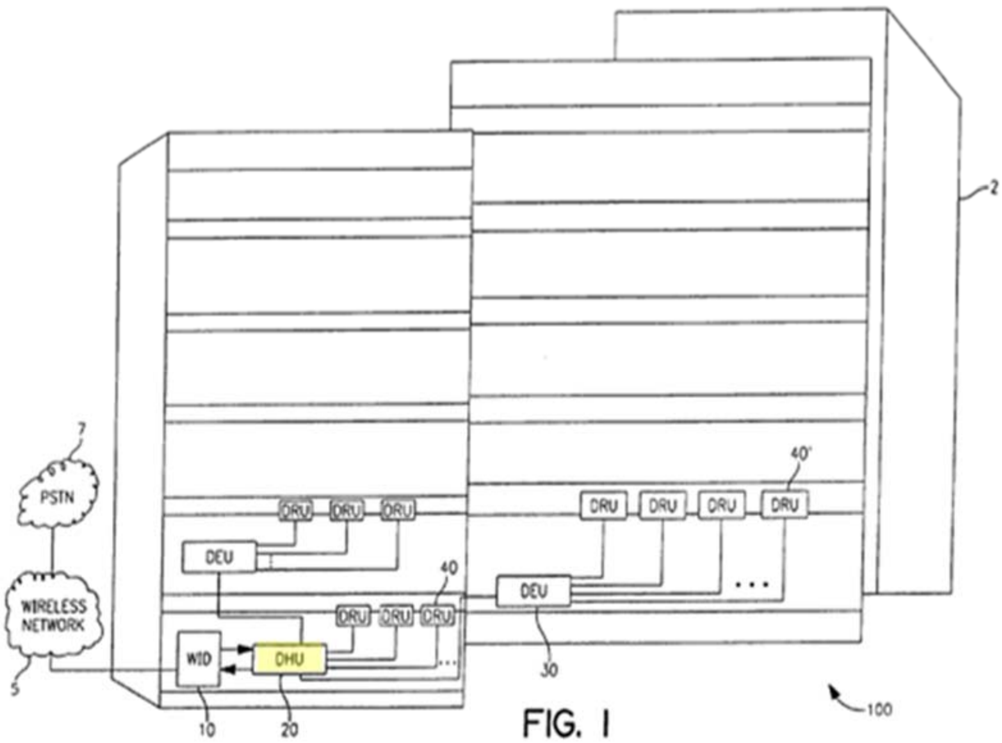
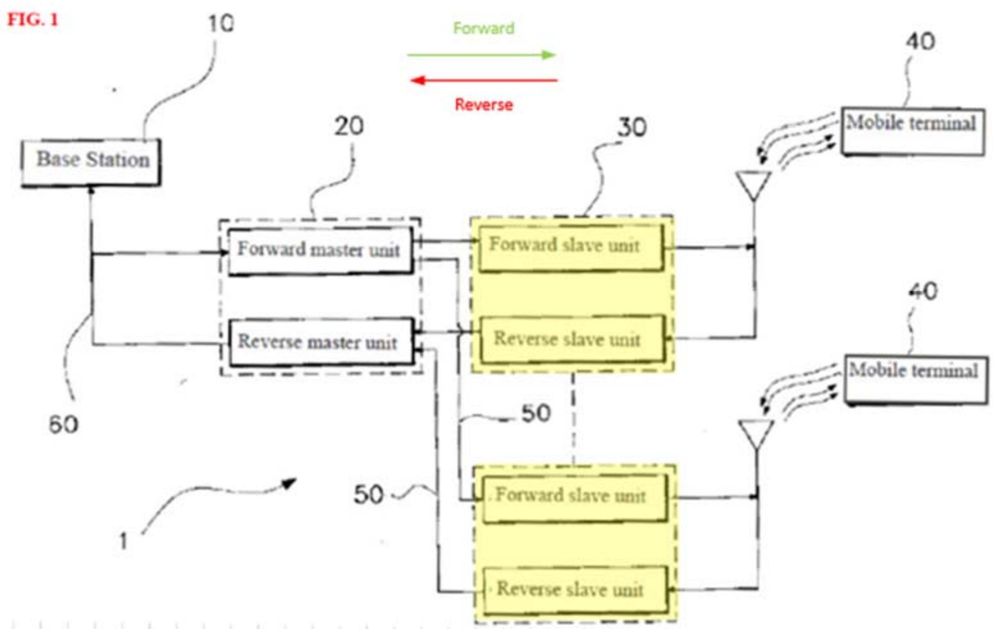


FIG. 1

Oh's slave units 30 convert "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. 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.



Oh's slave units 30 are analogous to the '402 patent's digital remote units (DRUs) that digitally communicate with the DHU via optic cables (Ex. 1004, 4:5-6) and wirelessly communicate with devices in their area (*e.g.*, via antenna 599).

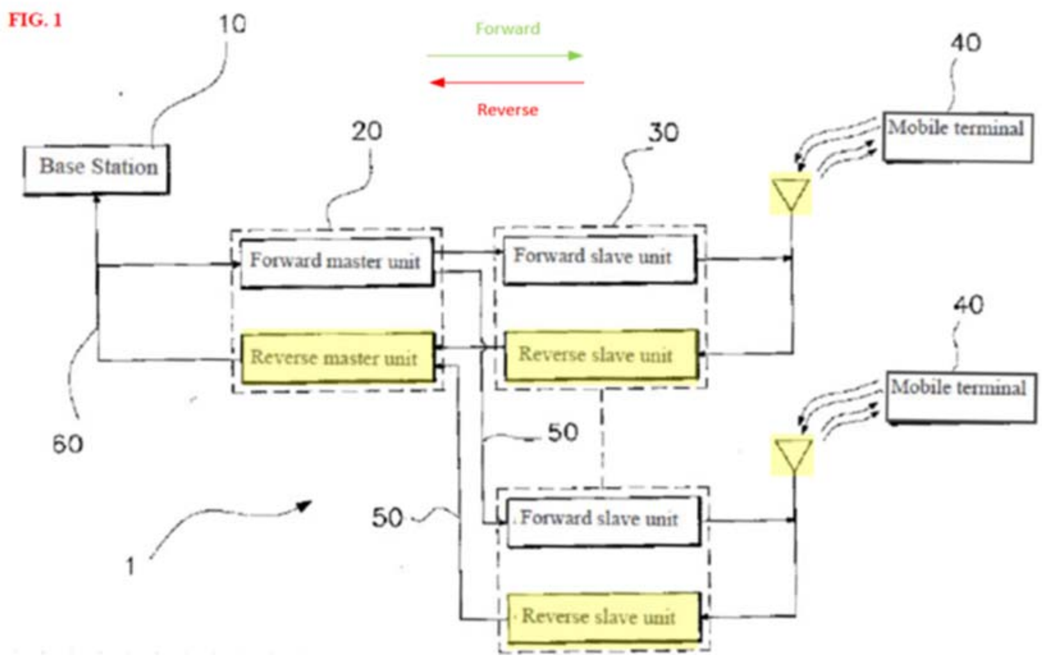
As discussed above, Oh, as evidenced by Fig. 5's depiction of master unit 20 communicating with base station 10 via an antenna, evidences the obviousness of wireless communications between a base station and master unit.

Thus Oh renders obvious a system for digital transport of a wireless spectrum (transmission of digital data among master unit 20 and slave unit 30 representative of analog signals transmitted wirelessly (*e.g.*, at 800 MHz, 1800MHz) to/from base station 10 via antenna), the system comprising: a first unit (20); and a plurality of second units (30) communicatively coupled to the first unit using at least one wired communication link (50) and remotely located from the first unit. Ex. 1005, ¶¶574-580.

(b) Element 3: "wherein each of the plurality of second units receives a respective analog wireless signal comprising the wireless spectrum and any transmissions from any wireless units within a respective coverage area associated with that second unit;"

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.

FIG. 1

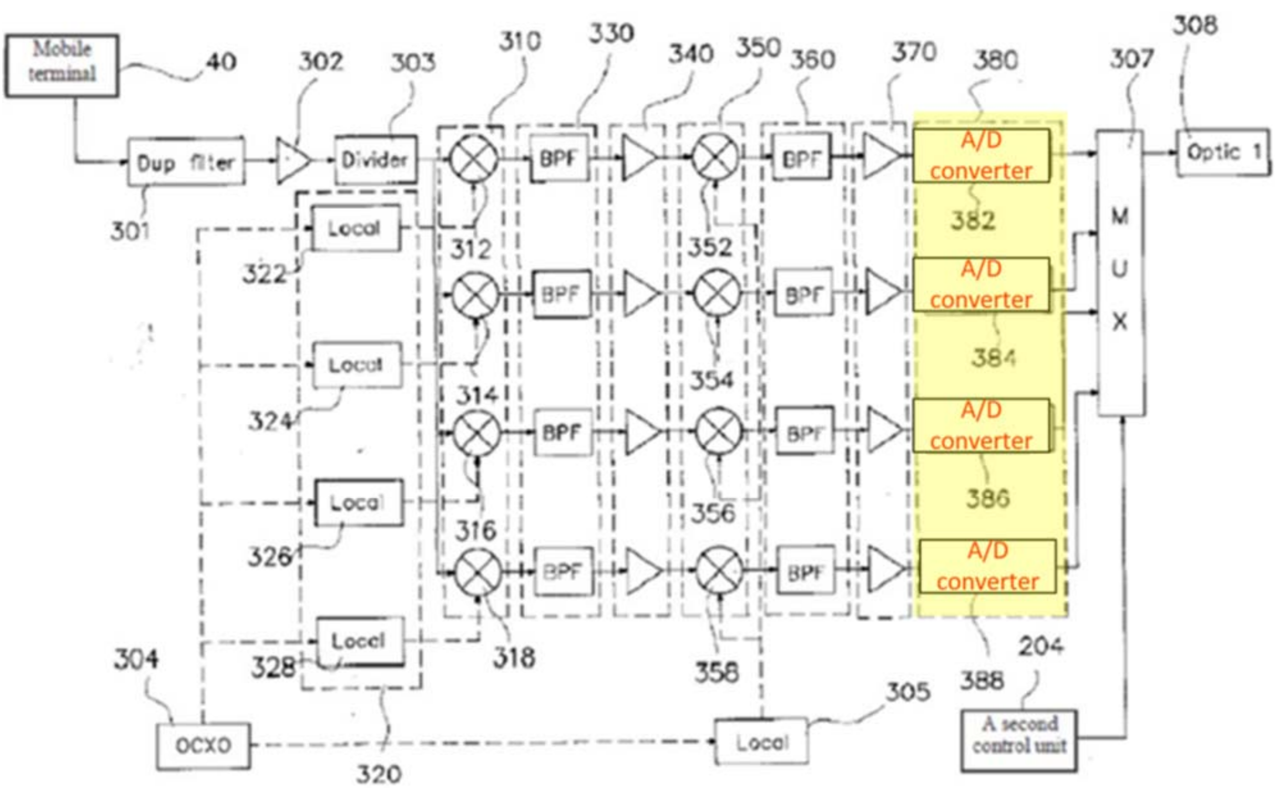


Thus Oh discloses each of the plurality of second units (30) receives a respective analog wireless signal comprising the wireless spectrum and any transmissions from any wireless units (40) within a respective coverage area associated with that second unit. Ex. 1005, ¶¶581-582.

(c) Element 4: "wherein each of the plurality of second units is configured to generate respective digital samples indicative of at least a portion of the wireless spectrum of the respective analog wireless signal received at that second unit;"

Oh discloses that each reverse slave unit 300 "converts the RF signals, analog signals, transmitted from the mobile terminals 40 through a third bi-directional filter 301, to the 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.

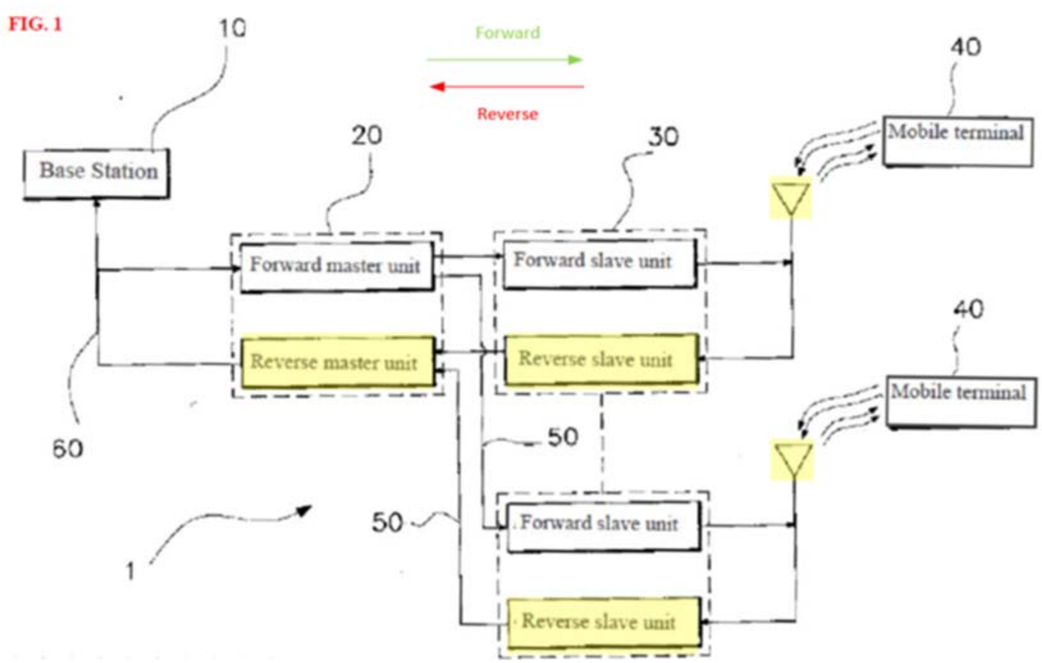
FIG. 4



Thus Oh renders obvious each of the plurality of second units (30) is configured to generate respective digital samples (at 380) indicative of at least a portion of the wireless spectrum of the respective analog wireless signal received at that second unit. Ex. 1005, ¶¶583-584.

(d) Element 5: "wherein each of the plurality of second units is configured to communicate the respective digital samples generated by that second unit to the first unit using the at least one wired communication link;"

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.

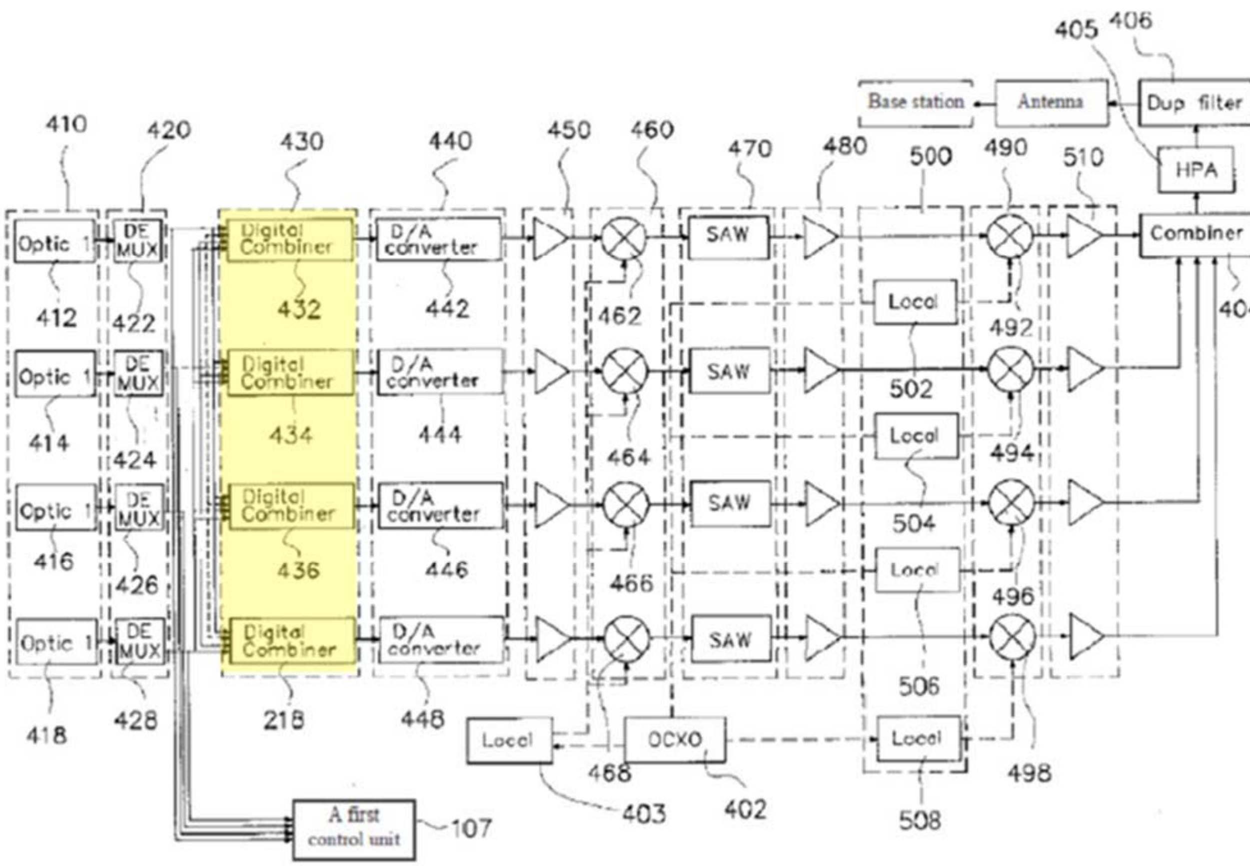


Thus Oh renders obvious each of the plurality of second units (30) is configured to communicate the respective digital samples generated by that second unit to the first unit (20) using the at least one wired communication link (50). Ex. 1005, ¶¶585-586.

(e) Element 6: "wherein the first unit is configured to digitally sum corresponding digital samples derived from the digital samples received from the plurality of second units to produce summed digital samples;"

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

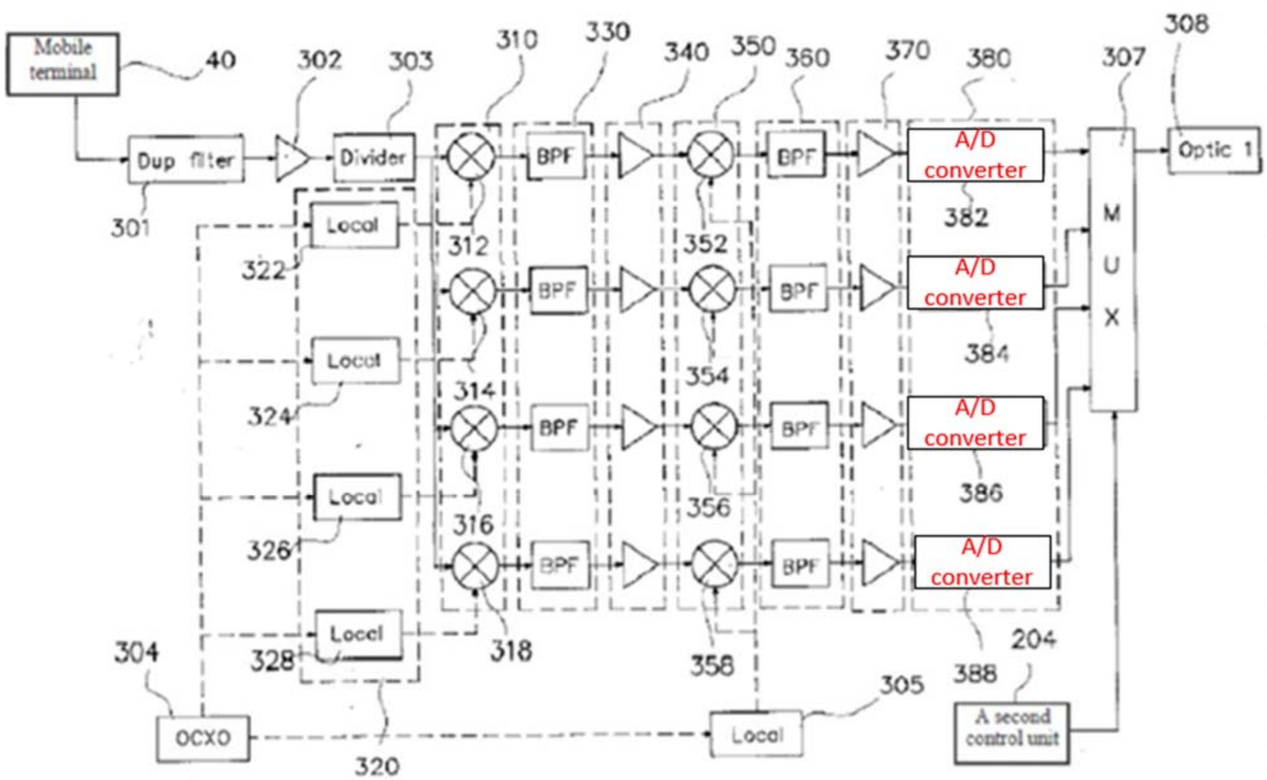
FIG. 5



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[2] 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.[3] Those 14-bit signals are then converted to analog signals (*i.e.*, analog combining) at 440, upconverted, combined, and transmitted to the base

[2] 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.

[3] This is evidenced by the CommScope patents themselves referring to their "sum" operation as "combining." *See*, Ex. 1004, 5:10-25 ("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.")

station 10. *Id.*, 5:17-29; Ex. 1005, ¶58.

Thus Oh renders obvious the first unit (20) is configured to digitally sum (at 430) corresponding digital samples derived from the digital samples received from the plurality of second units (30) to produce summed digital samples. Ex. 1005, ¶¶587-590.

(f) Element 7: "wherein the system is configured so that an input used for base station processing is derived from the resulting summed digital samples."

The term "base station processing" is not used in the '402 patent specification. But the Patent Owner has made clear its view that "base station processing" encompasses first (*i.e.*, host) unit functionality. In its complaint, Patent Owner maps Distribution and Aggregation Unit (DAU) to the "first unit" of claim 1, element 1. Ex. 1024, ¶54. Patent Owner then alleges that the same DAU alleged to be the "first unit" performs the "base station processing" of element 7. Specifically, Patent Owner states "DAU is configured to derive an input used for base station processing from the resulting summed digital samples. As seen, for example, in Figure 2.1 in paragraph 40 above, the upstream signal of the DAU is used as an input to a base station for base station processing." Ex. 1024, ¶61. Thus Patent Owner has argued that "base station processing" means processing signals in preparation/transmission of those processed signals to a base station, including at the first/host unit.

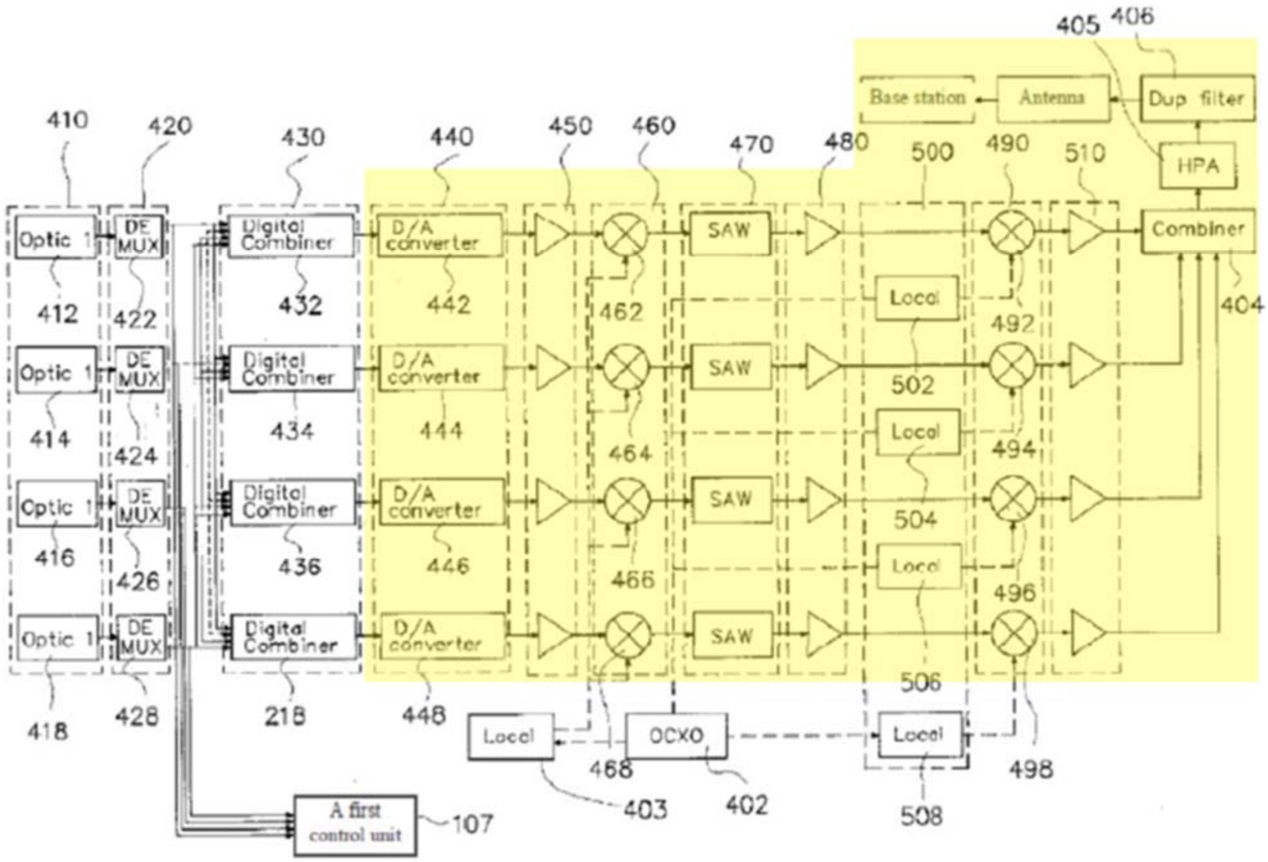
Claim 6 further corroborates that "base station processing" can encompass first/host unit functionality. Claim 6 states that "the base station processing functionality is at least one of: co-located with the first unit and remote from the first unit." Because claim 1 must necessarily be at least as broad, if not broader, than claim 6 (35 U.S.C. § 112, ¶4), "base station processing" in claim 1 also encompasses base station processing "co-located with the first unit."

Further, the '402 patent specification lacks description of performing processing of signals post-digital summing at a base station other than mere transmission of an analog signal to the base station. Ex. 1004, 5:61-6.

Thus, the "base station processing" recited by claim 1 cannot be limited to signal processing that is performed at a base station, because claim 6 necessarily means that "base station processing" can encompass first/host unit functionality, and because Patent Owner has accused what it alleges to be a first/host unit of performing base station functionality in litigation. Instead, "base station processing" should be understood for purposes of this proceeding to include processing signals in preparation/transmission of those processed signals to a base station including at a first/host unit.

Oh renders that limitation obvious. Following the digital summing operation referenced above in addressing element 6, the summed digital data values in Oh 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 and transmitted to a base station via an antenna.

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 442, 444, 446, and 448 of said first D/A converter unit 440 converts 14-bit digital signals to the intermediate [frequency] signals, analog signals; and transmits 1.23MHz or 1.5MHz intermediate frequency signals to each mixer 462, 464, 466, and 468 of a third mixer unit 460 through a third amplification unit 450. Said third mixer unit 460 outputs 70MHz intermediate frequency signals by mixing 1.23MHz or

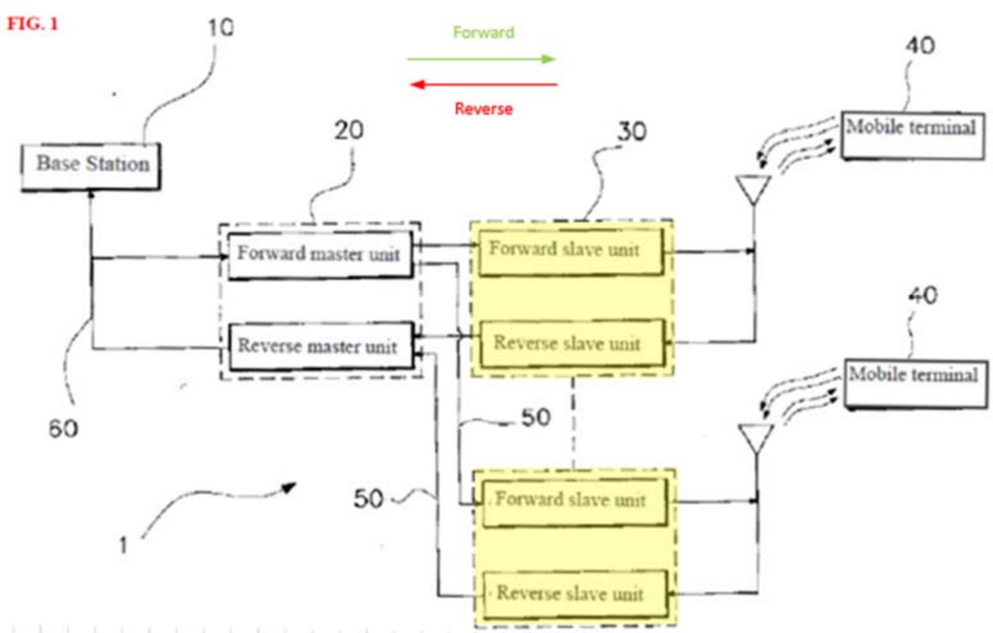
> 1.5MHz intermediate frequency signals transmitted from a first D/A converter unit 440 with 68.77MHz or 68.5MHz oscillating frequency transmitted from a third local unit 403. The intermediate frequency signals outputted from said third mixer unit 460 are transmitted to a fourth mixer unit 490 through 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 transmitted from a fourth local unit 500 with 70MHz intermediate frequency signals; 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 at 404 (*i.e.*, analog combining) 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. Ex. 1005, ¶58.

Thus Oh renders obvious the system is configured so that an input used for base station processing is derived from the resulting summed digital samples (the output of 430 is used as an input to circuitry at 440, 450, 460, 470, 480, 490, 520, 404, 405, 406 in preparation for transmission to the base station). *Id.*, ¶¶591-596.

2. Dependent Claim 2

Claim 2 recites "at least some of the plurality of second units are communicatively coupled to the first unit at least in part using a separate wired communication link." Fig. 1 of Oh discloses that each slave unit 30 is connected to master unit 20 via a distinct set of optic lines 50. (This is in contrast to when an intermediate expansion unit is used, where remote units downstream of an expansion unit share a link from the expansion unit to the host unit.)



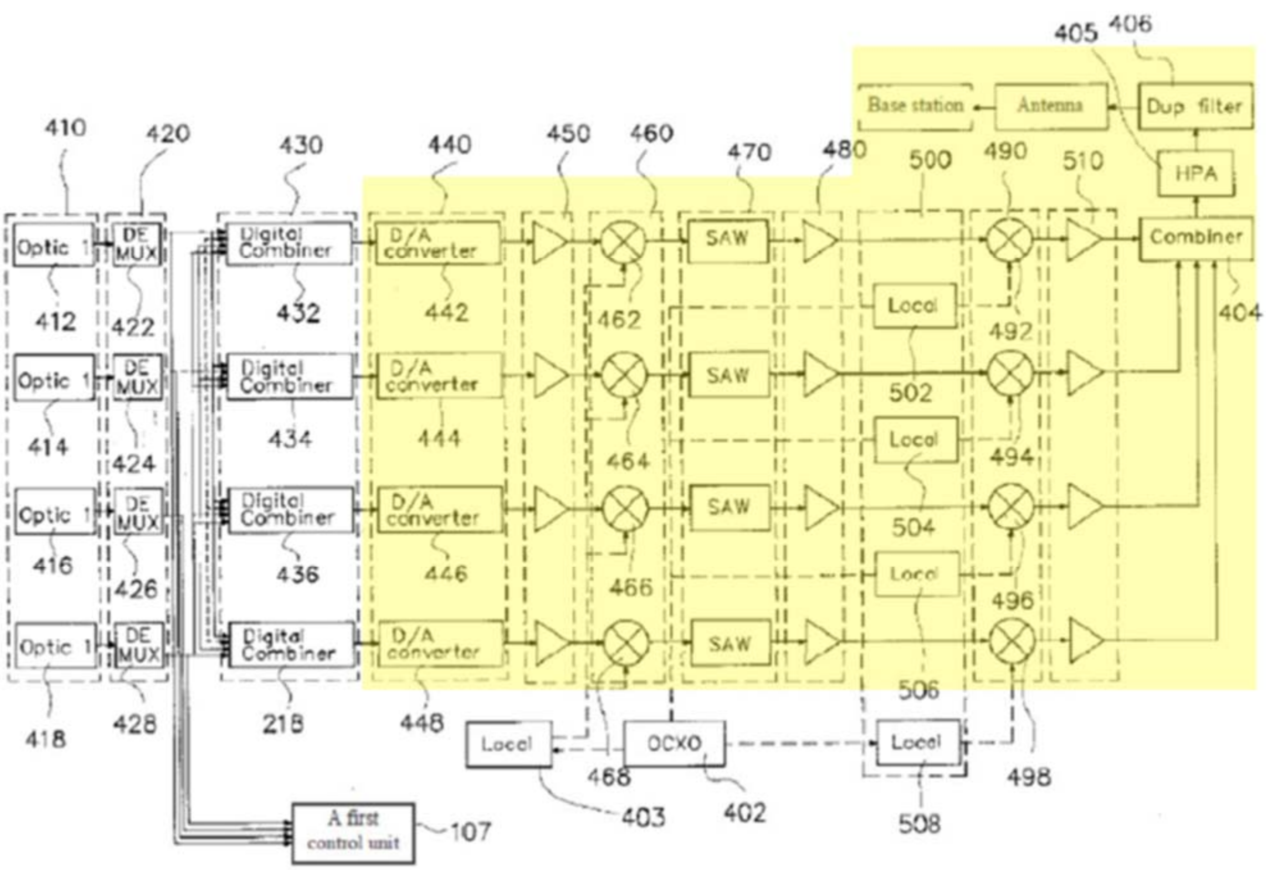
Thus Oh renders obvious at least some of the plurality of second units (30) are communicatively coupled to the first unit (20) at least in part using a separate wired communication link (50). Ex. 1005, ¶¶597-598.

3. Dependent Claim 5

Claim 5 recites "the system includes base station signal processing functionality configured to perform base station processing."

As discussed above with reference to claim 1, element 7, the digitally summed values from 430 are processed through the remainder of Fig. 5 of Oh in preparation for transmission to the base station, such as via the antenna depicted in Fig. 5. That processing in preparation for transmission to the base station includes D/A conversion at 440, amplification at 450, an initial upconversion at 460 followed by filtering at 470 and amplification at 480. Further upconversion of the frequency bands occurs at 490, followed by amplification at 510 and analog combining at 404 to form the replicated analog signal for transmission to the base station. That combined signal is amplified at 405 and transits a duplex filter 406 before transmission. Ex. 1007, 5:16-26.

FIG. 5

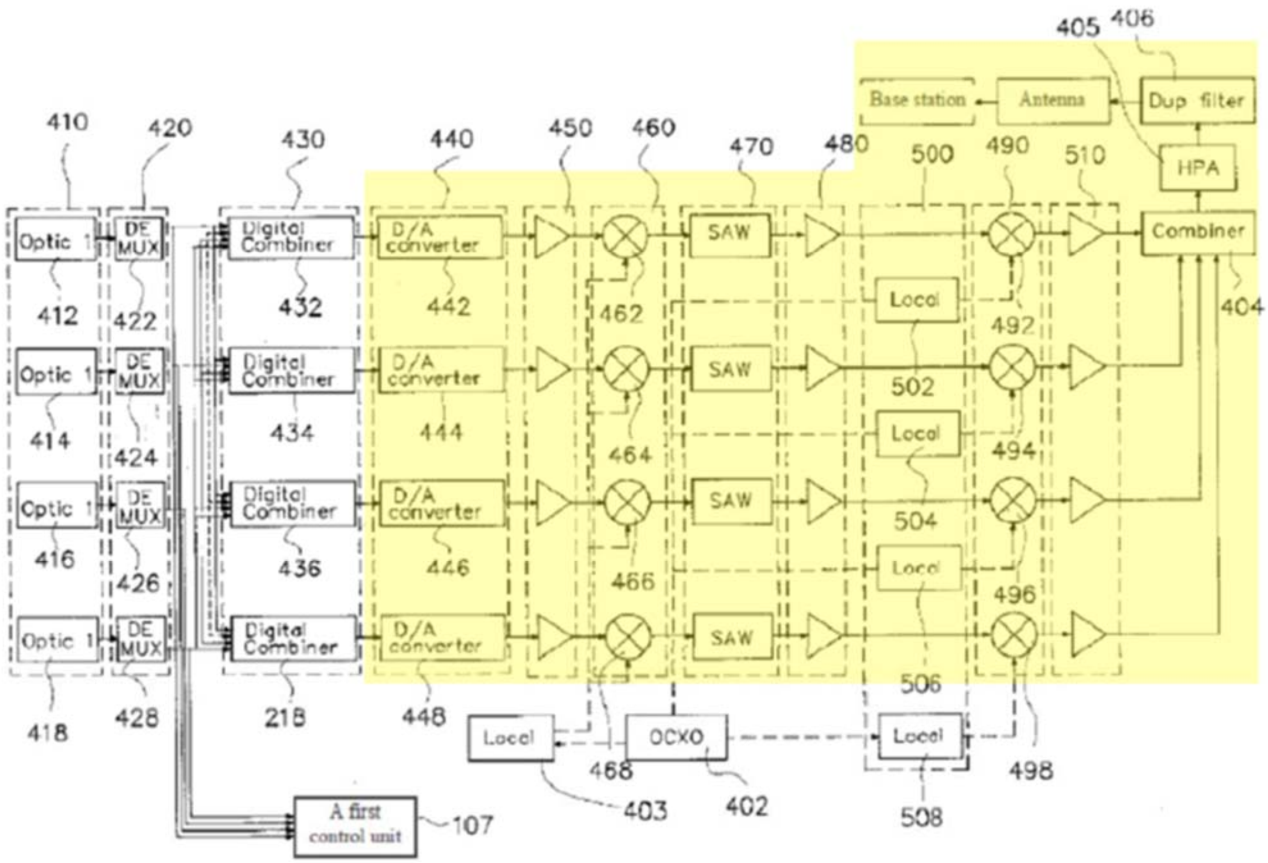


Thus Oh renders obvious the system including base station signal processing functionality (440, 450, 460, 470, 480, 490, 520, 404, 405, 406) configured to perform base station processing. Ex. 1005, ¶¶599-600.

4. Dependent Claim 6

Claim 6 recites "the base station processing functionality is at least one of: co-located with the first unit and remote from the first unit." As depicted in Fig. 5 of Oh, the base station processing (440, 450, 460, 470, 480, 490, 520, 404, 405, 406) occurs in master unit 20's reverse master unit 400. Ex. 1007, 4:65.

FIG. 5

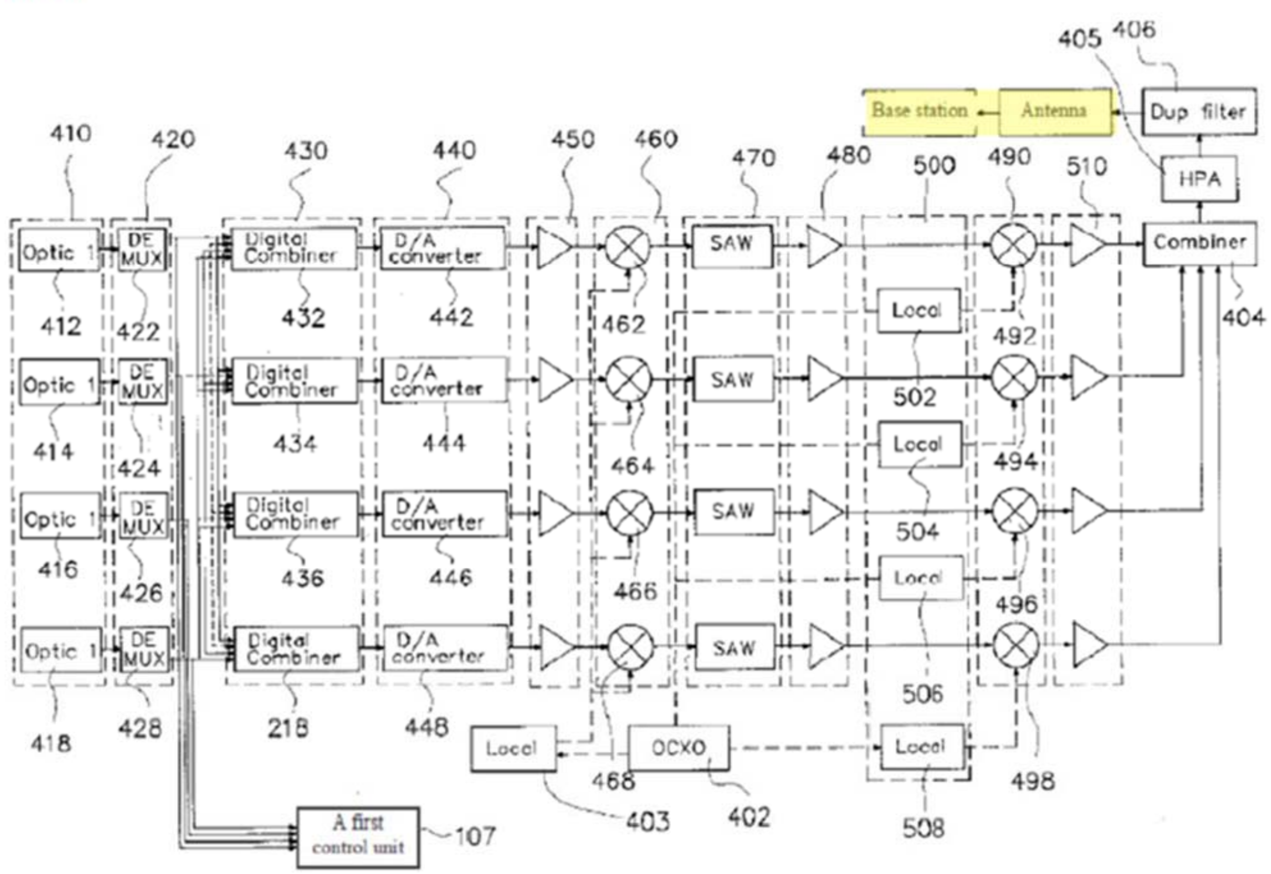


Thus in Oh the base station processing functionality (440, 450, 460, 470, 480, 490, 520, 404, 405, 406) is at least one of: <u>co-located with the first unit</u> (reverse master unit 400 at master unit 20) and remote from the first unit. Ex. 1005, ¶¶601-602.

5. Dependent Claim 7

Claim 7 recites "the system comprises at least a portion of a base station for performing the base station processing." As noted above with reference to claim 1, a POSITA would understand "base station processing" to mean processing signals in preparation/transmission of those processed signals to a base station. Oh discloses a system that culminates with transmission of analog RF signals to a base station, as highlighted below. Oh states that its "base station" "constitutes the mobile telecommunication network" and is thus involved in transmission of processed signals. Ex. 1007, 2:4-5.

FIG. 5

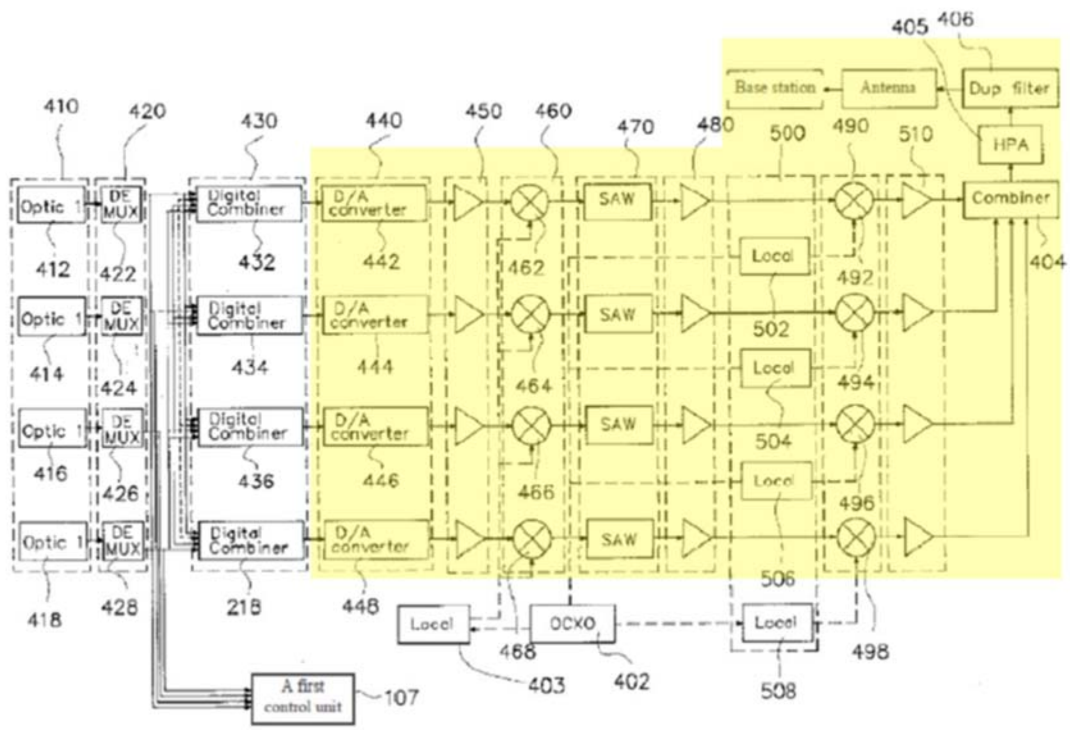


Thus Oh renders obvious the system comprises at least a portion of a base station (highlighted Fig. 5 Base station, "which constitutes the mobile telecommunications network") for performing the base station processing (processing signals in preparation/transmission of those processed signals to a base station). Ex. 1005, ¶¶603-604.

6. Dependent Claim 10

Claim 10 recites "the system is configured to convert the summed digital samples to a replicated analog wireless signal." Oh discloses that the output of digital combiner unit 430 (*i.e.*, the summed digital RF samples), are converted to analog signals at 440, upconverted to RF frequency signals at 450, 460, 470, 480, 490, 510, and combined at 404 (*i.e.*, analog combining) to form an analog signal that is transmitted to the base station. Ex. 1007, 5:16-26; Ex. 1005, ¶58.

FIG. 5



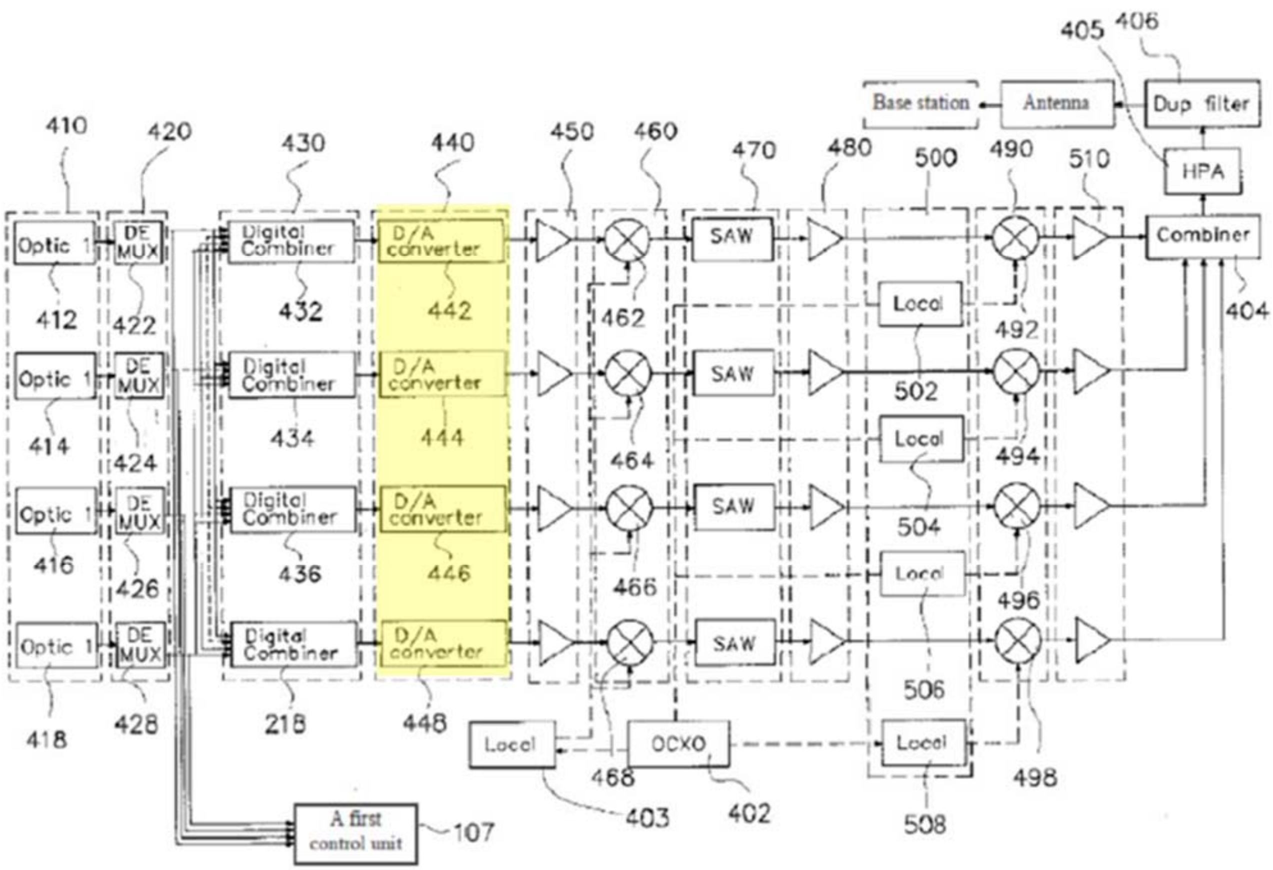
Thus Oh renders obvious the system is configured to convert the summed digital samples (output of 430) to a replicated analog wireless signal (via 450, 460, 470, 480, 490, 510, 404). Ex. 1005, ¶¶605-606.

7. Dependent Claim 11

Claim 11 recites "the system comprises a digital-to-analog converter to convert the summed digital samples to the replicated analog wireless signal."

As noted above, Oh discloses D/A converter unit 440 that receives the summed digital RF samples from 430 and converts them to analog signals, prior to those analog signals being up converted to form the replicated analog wireless frequency signal.

FIG. 5

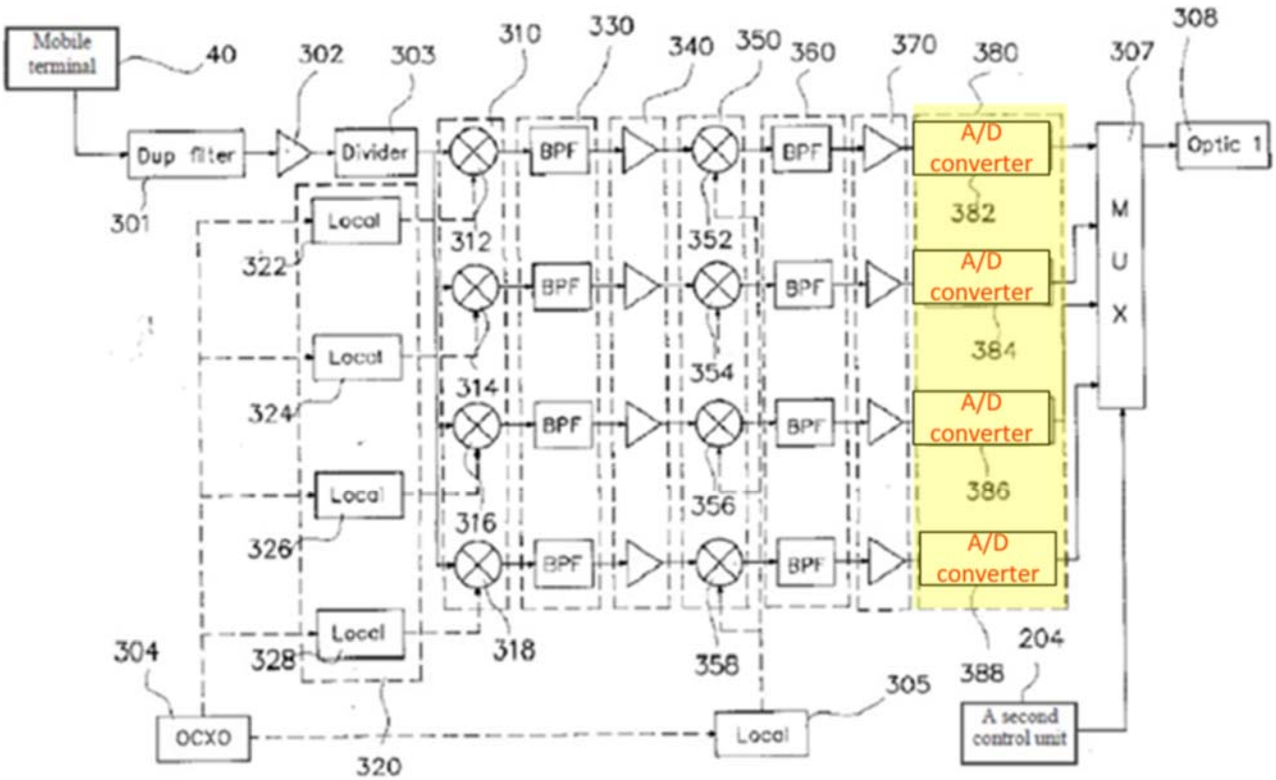


Thus Oh renders obvious the system comprises a digital-to-analog converter (440) to convert the summed digital samples (from 430) to the replicated analog wireless signal. Ex. 1005, ¶¶607-608.

8. Dependent Claim 12

Claim 12 recites "each of the plurality of second units comprises: a respective analog-to-digital converter to digitize the respective analog wireless signal received at that second unit in order to produce the respective digital samples." Oh discloses that each reverse slave unit 300 "converts the RF signals, analog signals, transmitted from the mobile terminals 40 through a third bi-directional filter 301, to the 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

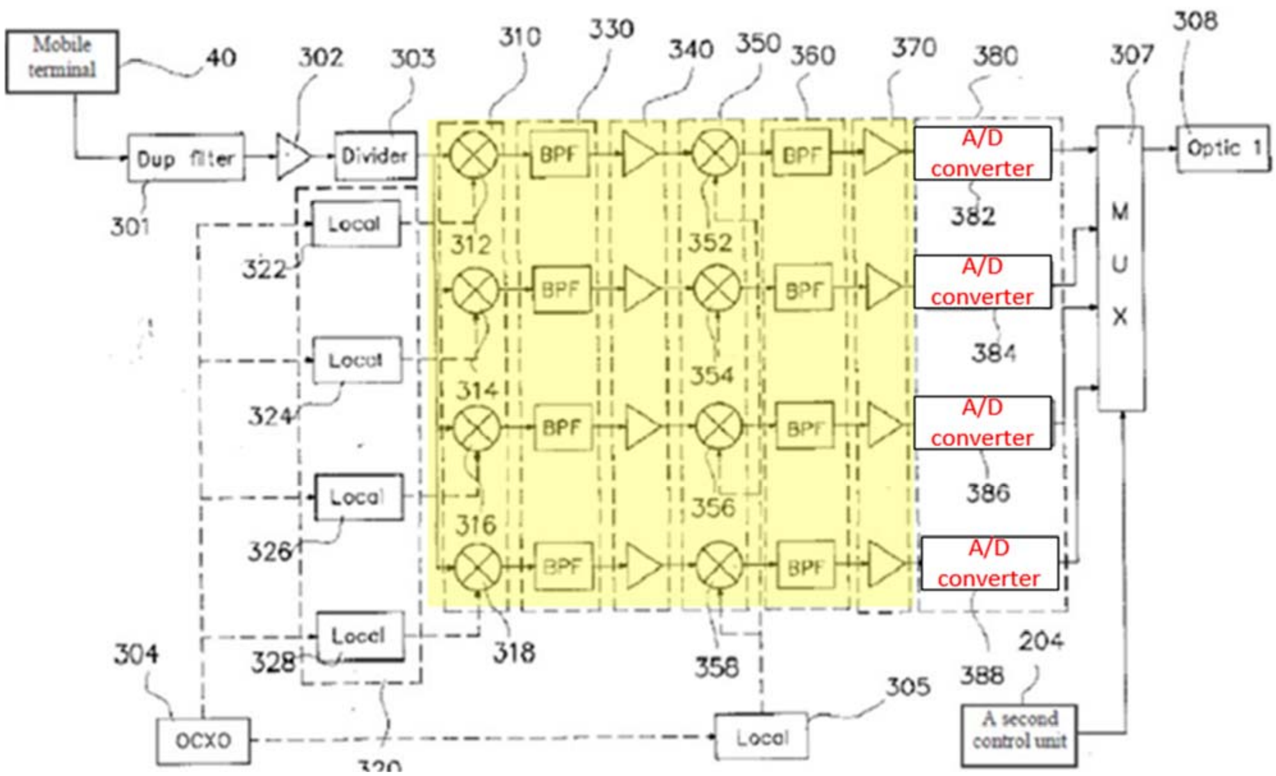


Thus Oh renders obvious each of the plurality of second units (30) comprises: a respective analog-to-digital converter (380) to digitize the respective analog wireless signal received at that second unit in order to produce the respective digital samples. Ex. 1005, ¶¶609-610.

9. Dependent Claim 13

Claim 13 recites "each of the plurality of second units generates the respective digital samples indicative of the respective analog wireless signal received at that second unit by frequency shifting the respective analog wireless signal received at that second unit and digitizing the frequency-shifted analog wireless signal." Oh discloses that each remote slave unit 30 includes circuitry for downconverting RF signals received from mobile terminals 40 to near DC prior to performing A/D conversion at 380. Specifically, a first stage of downconverting at 310 transitions signals from their near 800MHz bands to ~70MHz, followed by a second frequency shift from ~70MHz to near DC. Ex. 1007, 4:43-55.

FIG. 4



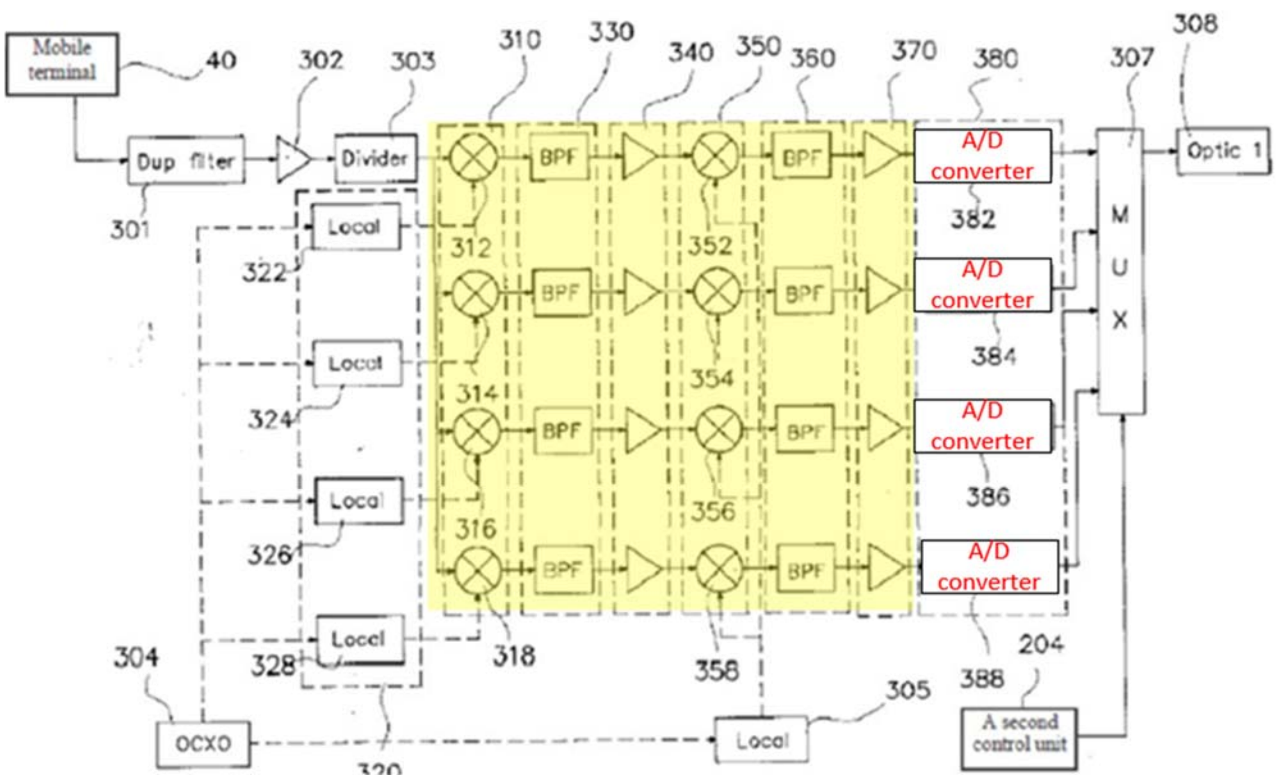
Thus Oh renders obvious each of the plurality of second units (30) generates the respective digital samples (at 380) indicative of the respective analog wireless signal received at that second unit (from 40) by frequency shifting (down converting at 310,

350) the respective analog wireless signal received at that second unit and digitizing (at 380) the frequency-shifted analog wireless signal. Ex. 1005, ¶¶611-612.

10. Dependent Claim 14

Claim 14 recites "each of the plurality of second units is configured to generate the respective digital samples indicative of the respective analog wireless signal received at that second unit by down converting the respective analog wireless signal received at that second unit and digitizing the down-converted analog wireless signal." As discussed above with reference to claim 13, each Oh remote slave unit downconverts received analog signals from ~800Mhz→~70MHz→~DC at 310, 350 prior to A/D conversion at 380.

FIG. 4

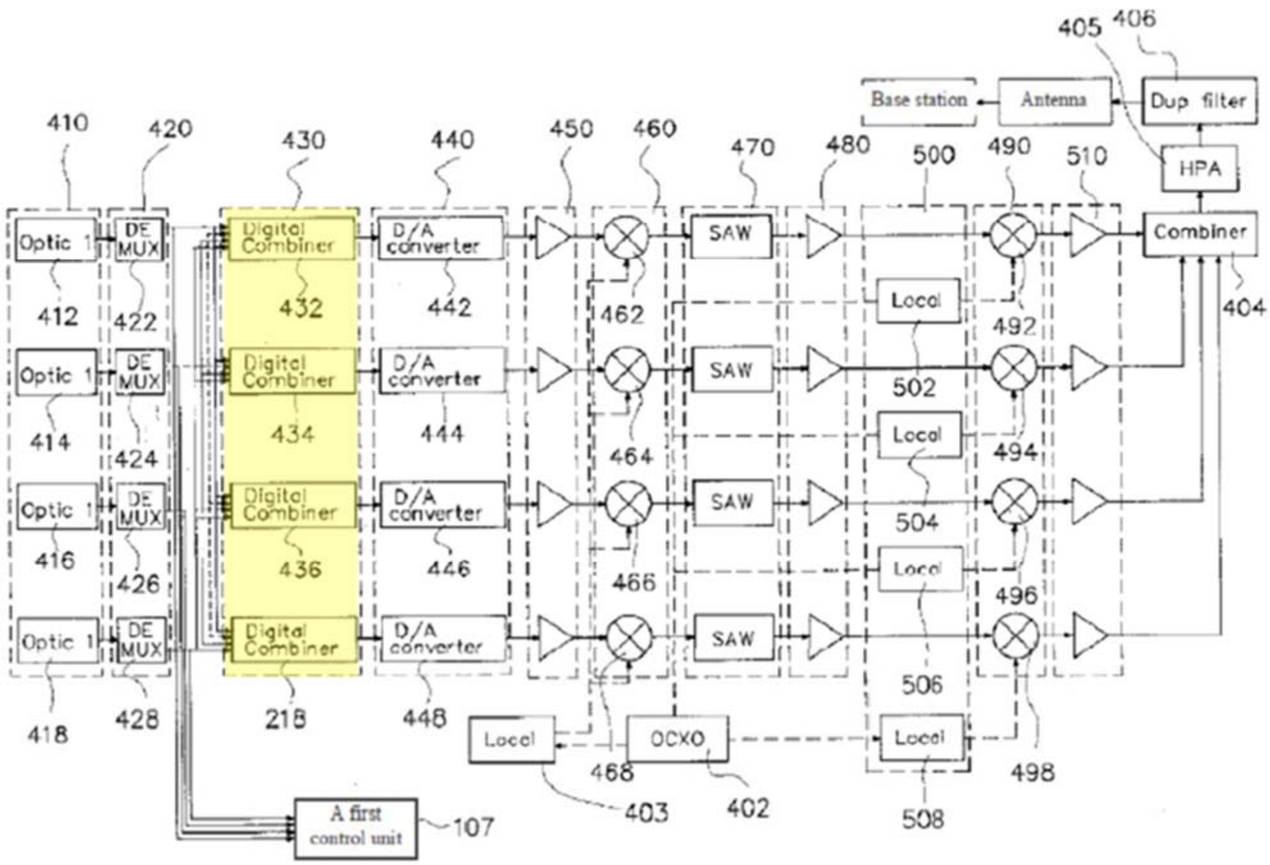


Thus Oh renders obvious each of the plurality of second units (30) is configured to generate the respective digital samples indicative of the respective analog wireless signal received at that second unit by down converting (at 310, 350) the respective analog wireless signal received at that second unit and digitizing (at 380) the down-converted analog wireless signal. Ex. 1005, ¶¶613-614.

11. Dependent Claim 15

Claim 15 recites "the first unit is configured to digitally sum the corresponding digital samples derived from the digital samples received from the plurality of second units as a part of generating the summed digital samples at a resolution greater than a resolution of the digital samples being summed." Oh discloses that its A/D converter unit 380 of slave unit 30 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 "creat[e] 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.

FIG. 5

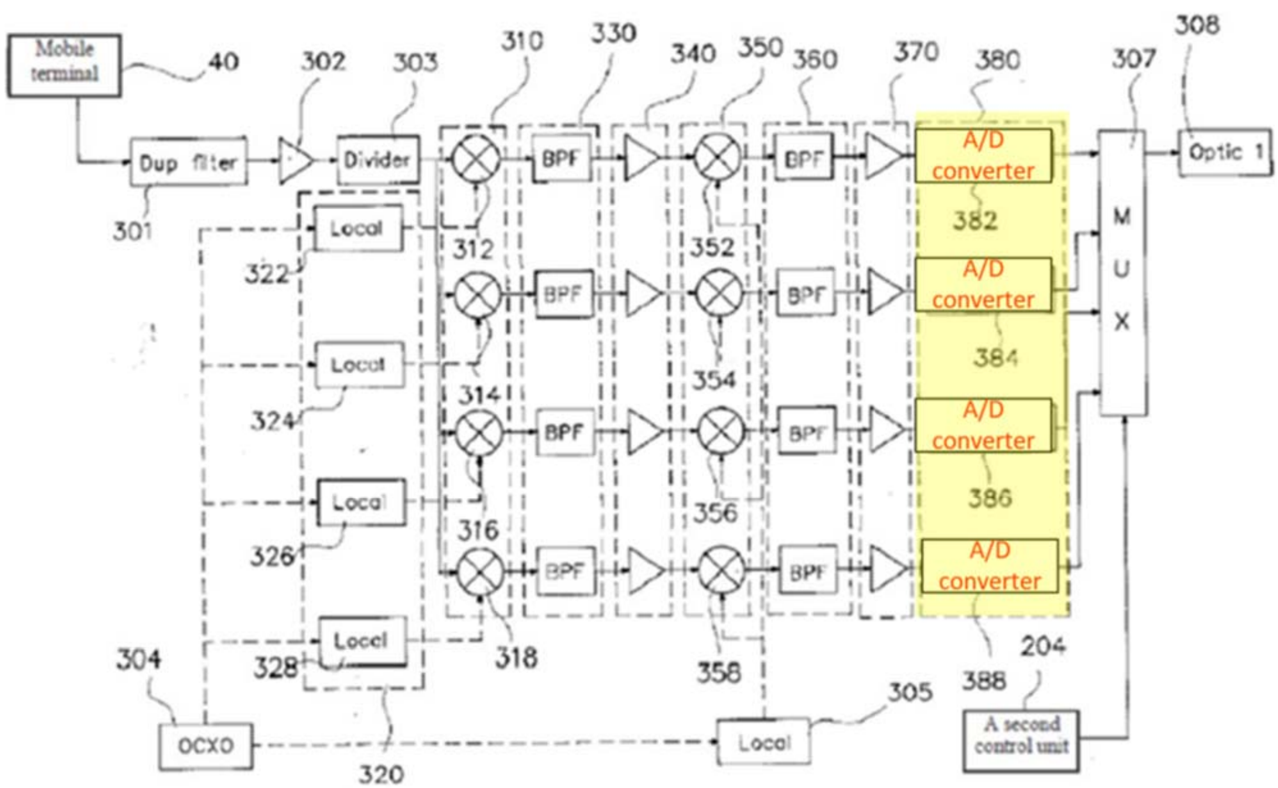


Thus Oh renders obvious the first unit (20) is configured to digitally sum (at 430) the corresponding digital samples derived from the digital samples received from the plurality of second units (30) as a part of generating the summed digital samples at a resolution (14 bits) greater than a resolution of the digital samples being summed (12 bits). Ex. 1005, ¶¶615-616.

12. Dependent Claim 16

Claim 16 recites "the wireless spectrum comprises a cellular radio frequency spectrum and any modulated transmissions from the wireless units carried by the cellular radio frequency spectrum of the wireless spectrum, and wherein the digital samples generated by and received from each of the second units comprise digital radio frequency samples in that the digital samples are indicative of the modulation of the transmissions carried by the cellular radio frequency spectrum of the wireless spectrum." Oh discloses receiving and operations on base station/mobile terminal signals at 800MHz and 1800MHz. Ex. 1007, 3:19, 4:40. Those 800MHz and 1800MHz examples are both within the cellular radio frequency spectrum. Ex. 1005, ¶617. Oh's remote slave units 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." Ex. 1007, 4:24-25.

FIG. 4

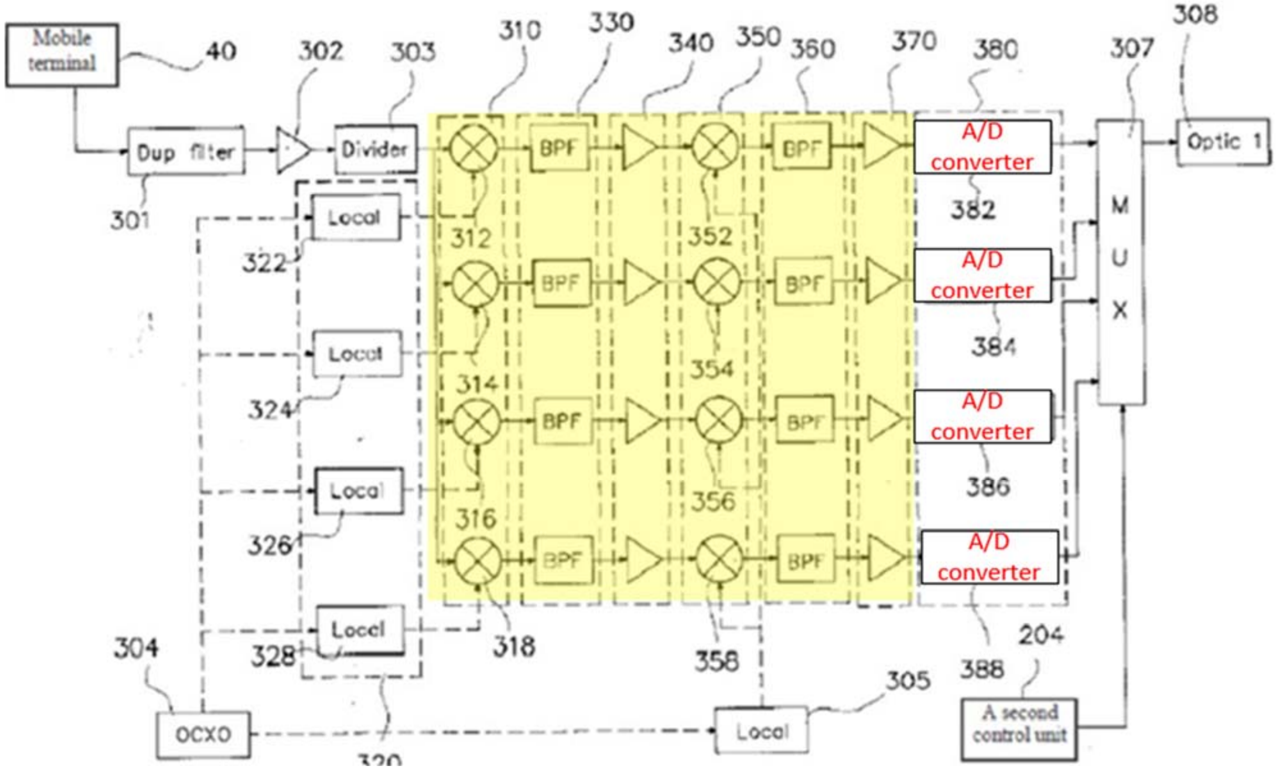


Thus Oh renders obvious the wireless spectrum comprises a cellular radio frequency spectrum (800MHz, 1800MHz) and any modulated transmissions from the wireless units (40) carried by the cellular radio frequency spectrum of the wireless spectrum, and wherein the digital samples generated by (380) and received from each of the second units (at Fig. 5, 410) comprise digital radio frequency samples in that the digital samples are indicative of the modulation of the transmissions carried by the cellular radio frequency spectrum of the wireless spectrum. Ex. 1005, ¶¶617-618.

13. Dependent Claims 17 and 18

Claim 17 recites "each of the second units is configured to perform a down-conversion in connection with generating the digital radio frequency samples," and claim 18 recites "each of the second units is configured to perform a down-conversion of an analog signal in connection with generating the digital radio frequency samples." As noted above with respect to claim 14, each Oh remote slave unit downconverts received analog signals from ~800Mhz→~70MHz→~DC at 310, 350 prior to A/D conversion at 380.

FIG. 4

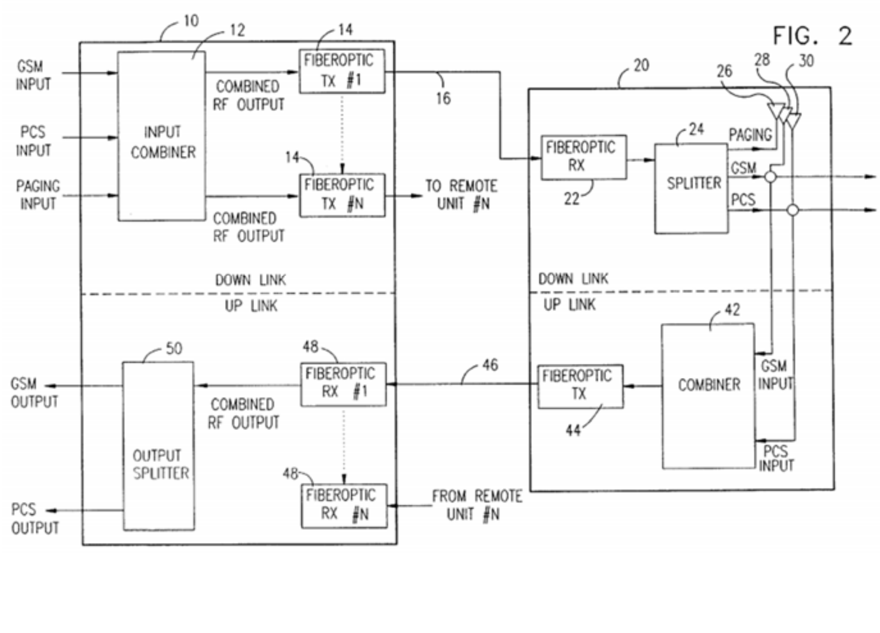


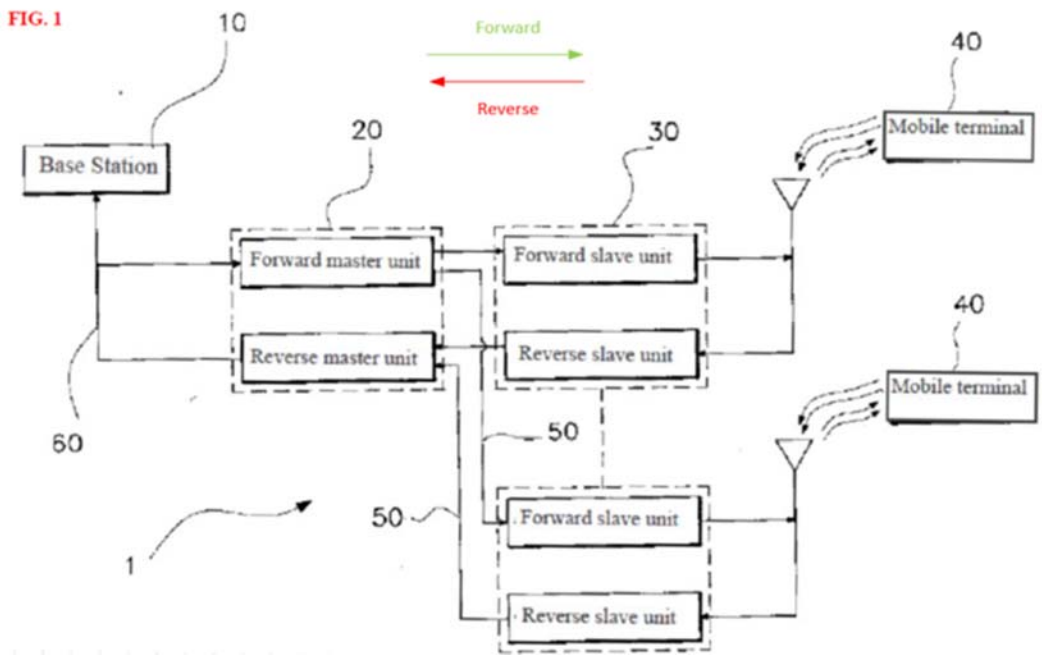
Thus Oh renders dependent claims 17 and 18 obvious. Ex. 1005, ¶619.

14. Dependent Claim 19

Claim 19 recites "the at least one wired communication link comprises at least one of: a single mode optical fiber, a multi-mode optical fiber, a coaxial cable, and a category cable."

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 single or 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.





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, ¶¶620-621.

15. Independent Claim 20

(a) Preamble: "A first unit used in digital transport of a wireless spectrum,"

To the extent the preamble is limiting, Oh renders the preamble obvious for the reasons provided above for the preamble of claim 1, where Oh describes a first unit (20) used in digital transport of a wireless spectrum (*e.g.*, 800 MHz, 1800MHz). Ex. 1005, ¶622.

(b) Element 1a: "at least one interface to communicatively couple the first unit to a plurality of second units using at least one wired communication link,"

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

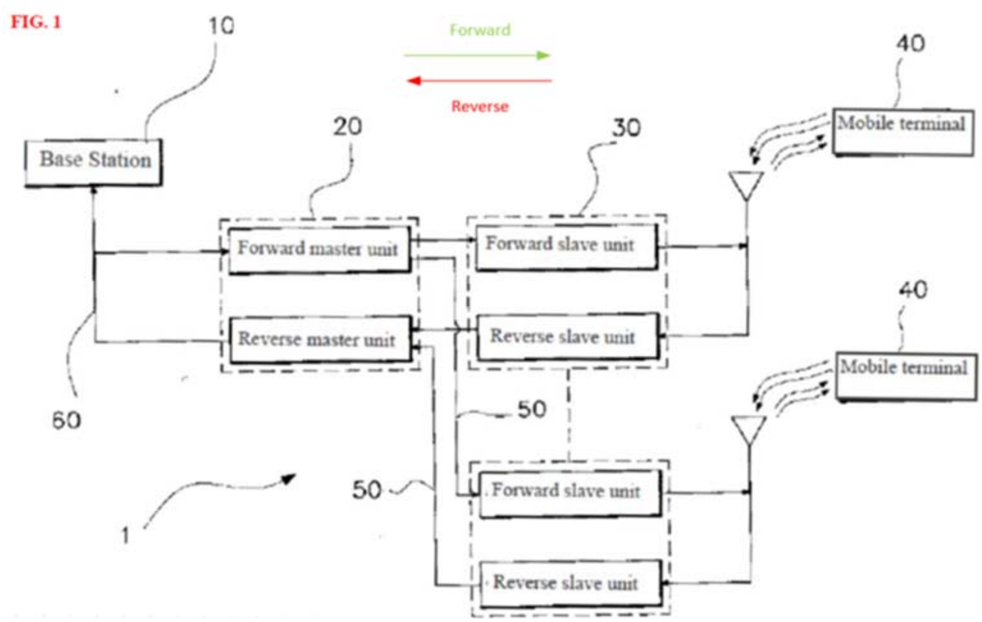
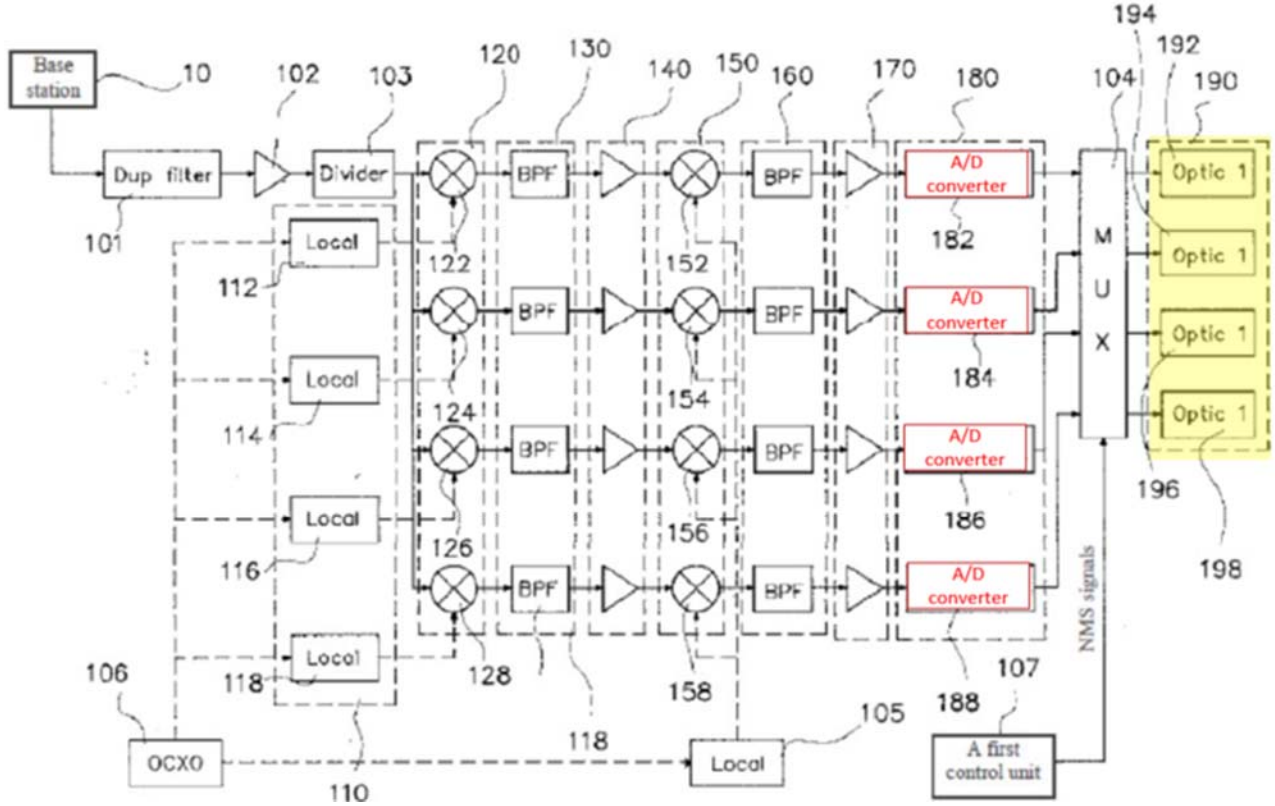


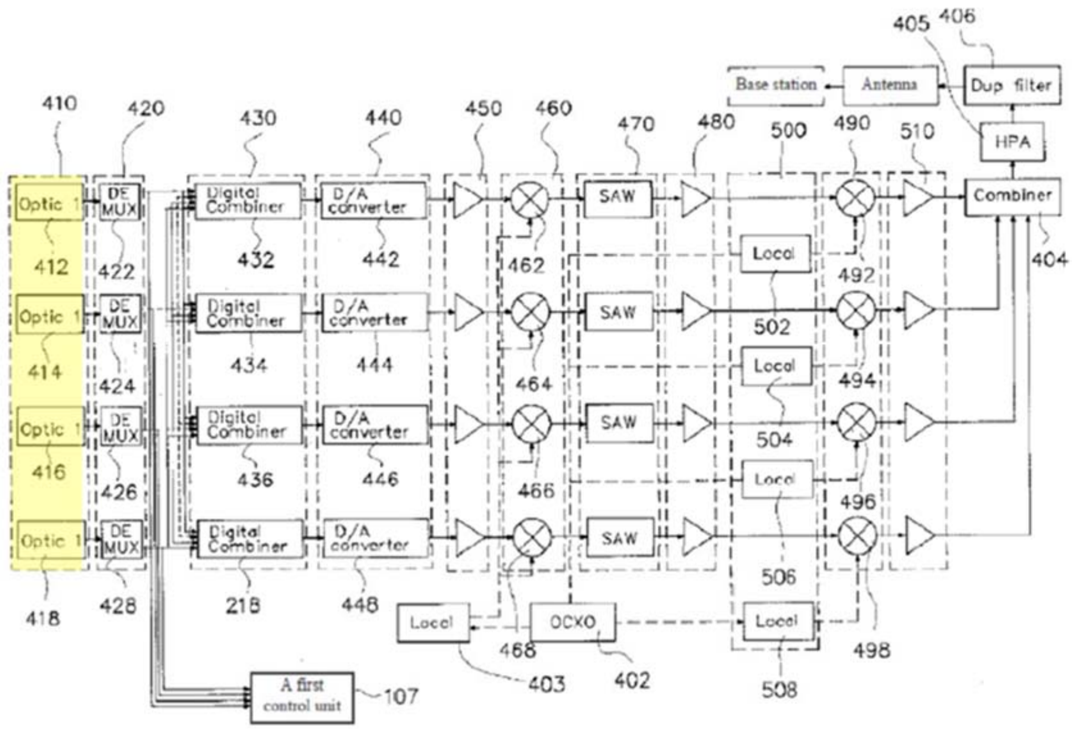
Fig. 2 of Oh depicts optic converter unit 190 that provides a downstream interface between master unit 20 and remote slave units 30.

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



Thus Oh renders obvious at least one interface (190, 410) to communicatively couple the first unit (20) to a plurality of second units (30) using at least one wired communication link (50). Ex. 1005, ¶¶623-624.

(c) Element 1b: "wherein each of the plurality of second units is remotely located from the first unit and each of the plurality of second units receives a respective analog wireless signal comprising the wireless spectrum and any transmissions from any wireless units that are within a coverage area associated with that second unit"

Oh renders element 1b obvious for the reasons provided above with respect to elements 2 and 3 of claim 1. Ex. 1005, ¶625.

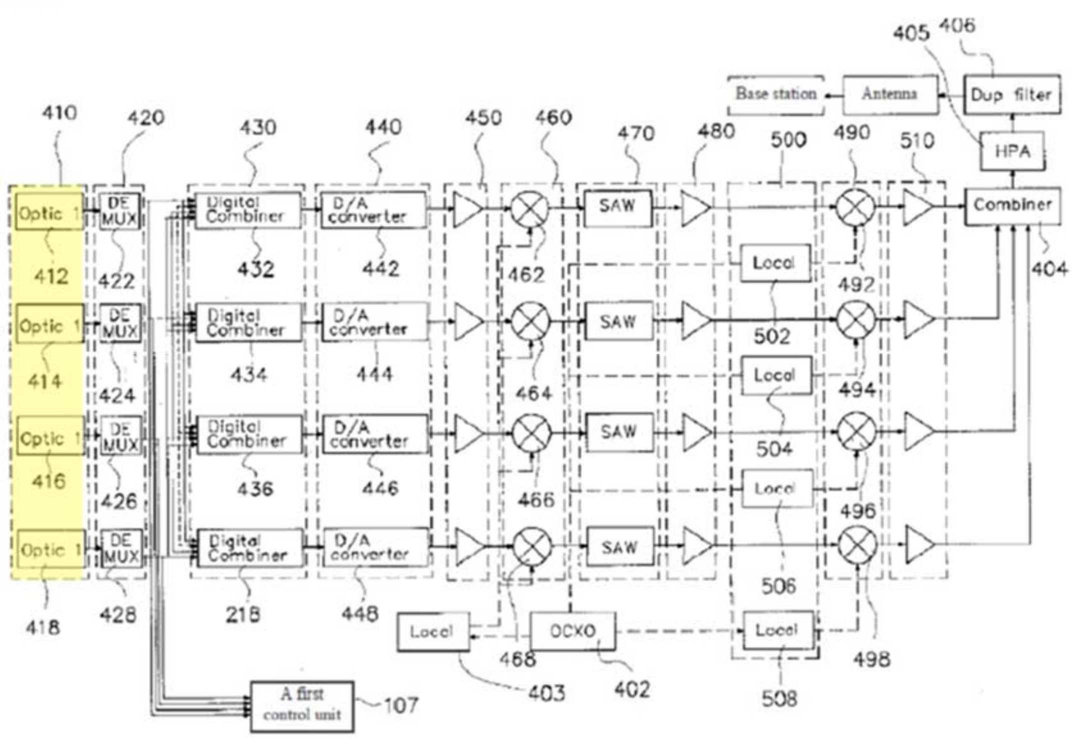
(d) Element 1c: "wherein each of the plurality of second units is configured to generate respective digital samples indicative of at least a portion of the wireless spectrum of the respective analog wireless signal received at that second unit,"

Oh renders element 1c obvious for the reasons provided above with respect to element 4 of claim 1. Ex. 1005, ¶626.

(e) Element 1d: "wherein the interface is used to receive the digital samples from the plurality of second units;"

Oh Fig. 5 illustrates optic converter unit 410 that provides an upstream interface from slave units 30 to master unit 20 that receives "the serial data signals transmitted from each slave unit 30." Ex. 1007, 4:65-67.

FIG. 5



Thus Oh renders obvious the interface (410) is used to receive the digital samples from the plurality of second units (30). Ex. 1005, ¶627.

(f) Element 2: "a digital summer to digitally sum corresponding digital samples derived from the digital samples received from the plurality of second units to produce summed digital samples;"

Oh renders element 2 obvious for the reasons provided above for claim 1, element 6, where combiners 432, 434, 436, 438 sum digital samples received from the remote slave units 30 to produce summed digital samples. Ex. 1005, ¶628.

(g) Element 3: "wherein the first unit is configured so that an input used for base station processing is derived from the resulting summed digital samples."

Oh renders element 3 obvious for the reasons provided above for claim 1, element 7. Ex. 1005, ¶629.

16. Dependent Claim 21

Dependent claim 21 is rendered obvious by Oh for the reasons provided above for claim 2, where at least some of the plurality of second units (30) are communicatively coupled to the first unit (20) at least in part using a separate wired communication link (50), wherein the first unit comprises a separate interface (Fig. 2, 192, 194, 196, 198 in the forward direction; Fig. 5, 412, 414, 416, 418 in the reverse direction) configured to communicatively couple the first unit to each of said at least some of the plurality of second units using the respective separate wired communication link. Ex. 1005, ¶630.

17. Dependent Claims 24-25 and 27-30

Dependent claims 24-25 and 27-30 are rendered obvious by Oh for the reasons provided above for claims 36, 7, 10, 11, 15, and 16, respectively. Ex. 1005, ¶631.

18. Independent Claim 31

(a) Preamble: "A method for digital transport of a wireless spectrum used with a first unit and a plurality of second units, each of the plurality of second units being remotely located from the first unit, the method comprising:"

To the extent the preamble is limiting, it is rendered obvious by Oh for the reasons provided above for the preamble and elements 1-2 of claim 1, which included discussion of Oh's disclosed technique for digitally transporting radio frequency signals (*e.g.*, 800 MHz, 1800 MHz) from the base station and through the master unit 20 and slave units 30. Thus the Oh system provides digital transport (over optic lines 50) of a wireless spectrum (RF signals received from the base station) used with a first unit (20) and a plurality of second units (30), each of the plurality of second units being remotely located from the first unit. Ex. 1005, ¶632.

(b) Element 1: "at each of the plurality of second units: receiving a respective analog wireless signal comprising the wireless spectrum and any transmissions from any of the wireless units that are within a coverage area associated with that second unit;"

Element 1 is rendered obvious by Oh for the reasons provided above for claim 1, element 3. Ex. 1005, ¶633.

(c) Element 2: "generating respective digital samples indicative of at least a portion of the wireless spectrum of the respective analog wireless signal received at that second unit;"

Element 2 is rendered obvious by Oh for the reasons provided above for claim 1, element 4. Ex. 1005, ¶634.

(d) Element 3: "communicating the respective digital samples generated by that second unit to the first unit using at least one communication medium;"

Element 3 is rendered obvious by Oh for the reasons provided above for claim 1, element 5. Ex. 1005, ¶635.

(e) Element 4: "at the first unit, digitally summing corresponding digital samples derived from the digital samples received from the plurality of second units to produce summed digital samples."

Element 4 is rendered obvious by Oh for the reasons provided above for claim 1, element 6. Ex. 1005, ¶636.

19. Dependent Claim 35

Claim 35 recites "performing base station processing using an input derived from the resulting summed digital samples." Oh renders this limitation obvious for the reasons provided above for claim 1, element 7. Ex. 1005, ¶637.

20. Dependent Claims 32 and 36-42

Dependent claims 32 and 36-42 are rendered obvious by Oh for the reasons provide above for claims 2, 6, 7, 10, 15, 16, 13, and 14, respectively. Ex. 1005, ¶638.

21. Independent Claim 43

(a) Preamble and Elements 1-6

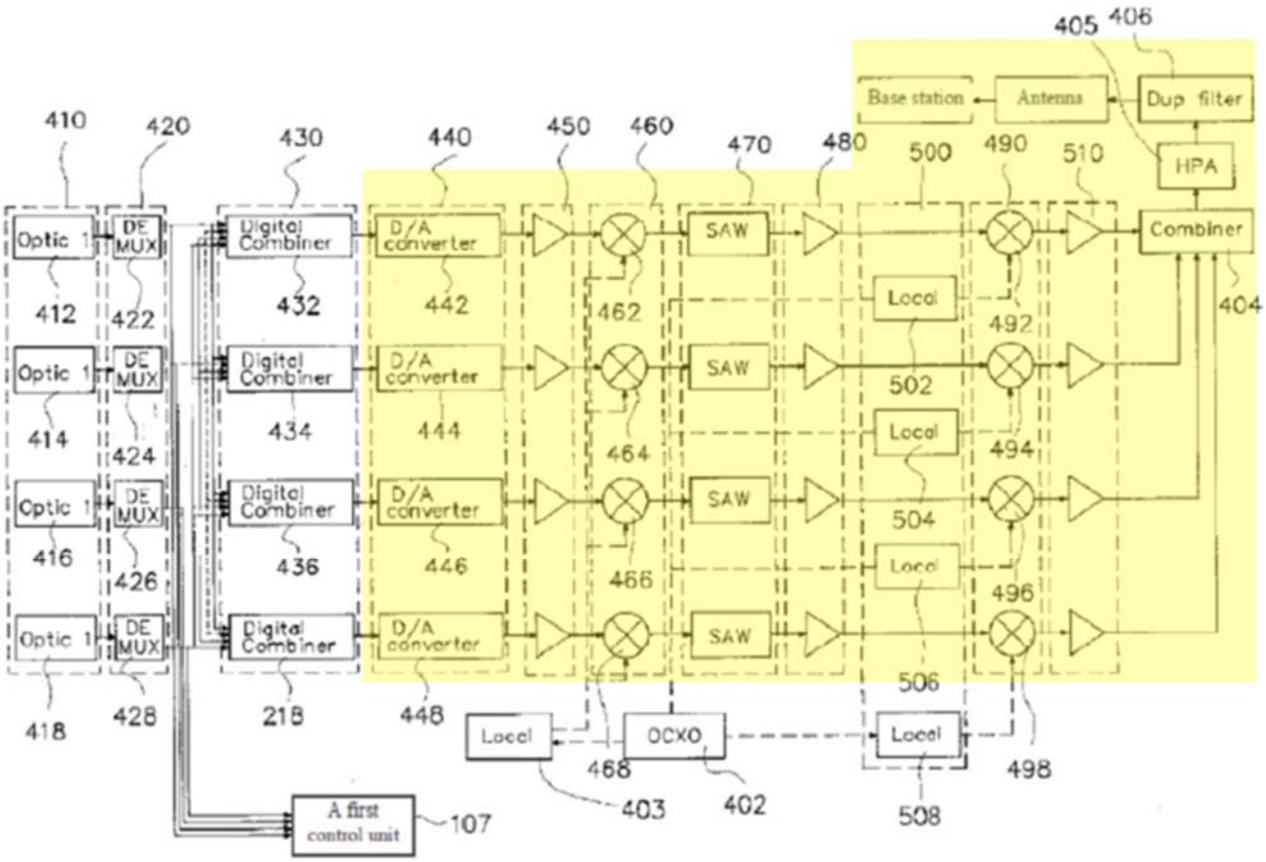
Oh renders the preamble and elements 1-6 of claim 43 obvious for the reasons provided above for the preamble and elements 1-6 of claim 1. Ex. 1005, ¶639.

(b) Element 7: "wherein the system is configured so that an input used for wireless protocol processing is derived from the resulting summed digital samples"

The term "wireless protocol processing" is not used in the '402 patent specification. As discussed above, POSITA would understand "wireless protocol processing" to mean processing signals in preparation/transmission of those processed signals according to a wireless protocol.

Oh renders that limitation obvious. Following the digital summing operation referenced above in addressing element 6, the summed digital data values in Oh 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 and wirelessly transmitted to a base station via an antenna.

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 442, 444, 446, and 448 of said first D/A converter unit 440 converts 14-bit digital signals to the intermediate [frequency] signals, analog signals; and transmits 1.23MHz or 1.5MHz intermediate frequency signals to each mixer 462, 464, 466, and 468 of a third mixer unit 460 through a third amplification unit 450. Said third mixer unit 460 outputs 70MHz intermediate frequency signals by mixing 1.23MHz or 1.5MHz intermediate frequency signals transmitted from a first D/A converter unit 440 with 68.77MHz or 68.5MHz oscillating frequency

> transmitted from a third local unit 403. 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 transmitted from a fourth local unit 500 with 70MHz intermediate frequency signals; 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 at 404 (*i.e.*, analog combining) 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. Ex. 1005, ¶58.

Thus Oh renders obvious wherein the system is configured so that an input used for wireless protocol processing is derived from the resulting summed digital samples (the output of 430 is used as an input to circuitry at 440, 450, 460, 470, 480, 490, 520, 404, 405, 406 in preparation for wireless transmission to the base station). Ex. 1005, ¶¶640-642.

22. Dependent Claims 44, 47, and 48

Dependent claims 44, 47, and 48 are rendered obvious by Oh for the reasons provided above for claims 2, 6, and 7, respectively. Ex. 1005, ¶643.

23. Independent Claim 51

(a) Preamble and Elements 1 and 2

The preamble and elements 1 and 2 are rendered obvious by Oh for the reasons provided above for the preamble and elements 1 and 2 of claim 20 above. Ex. 1005, ¶644.

(b) Element 3: "wherein the first unit is configured so that an input used for wireless protocol processing is derived from the resulting summed digital samples"

Element 3 of claim 51 is rendered obvious by Oh for the reasons provided above for element 7 of claim 43. Ex. 1005, ¶645.

24. Dependent Claims 52, 55, and 56

Dependent claims 52, 44, and 56 are rendered obvious by Oh for the reasons provided above for claims 21, 6, and 7, respectively. Ex. 1005, ¶646.

C. Ground 1b: Claims 3, 4, 22, 23, 33, 34, 45, 46, 53, and 54 are unpatentable under 35 U.S.C. § 103 over Oh in view of Schwartz;

1. Motivation to Combine

A person of ordinary skill in the art would be motivated to combine the disclosures of Oh and Schwartz for a variety of reasons. As an initial matter, Oh expressly mentions the types of all-analog RF distribution system described by Schwartz in its "Conventional Technology" section, where Oh notes that in those systems where "the RF signals transmitted/received to/from said first optic repeater and a second optic repeater are analog signals, the strength of the signals is greatly decreased during transmission through the optical line." Ex. 1007, 2:29-30. The resulting amplification can cause signal-to-noise ratio issues in the analog signals that ultimately reach destinations at the host or remote units. *Id*., 2:30-33. Because Oh expressly discusses the types of conventional, all-analog systems described in Schwartz, a POSITA would have recognized compatibilities in those systems and that Oh's digital relay improvements would have been applicable to Schwartz-type topologies (*i.e.*, topologies that incorporate intermediate stations 28 for distribution network expansion).

Additionally, a POSITA starting with Oh would have readily recognized a limitation in Oh's disclosure, where an RF distribution topology would have been limited to the number of remote slave units 30 corresponding to the number of master unit 20 optical ports (*i.e.*, four optic converters 192, 194, 196, 198 on the forward path and four optic converters 412, 414, 416, 418 on the reverse path limit master unit 20 to connection to four slave units 30). Schwartz's topology that supports intermediate stations 28 for RF distribution network expansion beyond the number of physical ports available at the host (*i.e.*, central station 20). Fig. 1 of Schwartz depicts the ability to daisy-chain intermediate stations 28 together such that a Schwartz network can be expanded to "any number of intermediate stations 28 and/or remote stations 22." Ex. 1010, 4:33-38. Thus a POSITA starting with Oh but looking to provide a large RF distribution network (*e.g.*, in a large building, a sports arena) would be motivated to utilize Schwartz intermediate stations 28 to facilitate that expansion. Ex. 1005, ¶¶647-648.

2. Dependent Claim 3

Claim 3 recites "at least some of the plurality of second units are communicatively coupled to the first unit at least in part using a shared wired communication link." Schwartz discloses an RF distribution network whereby external RF signals are transmitted to remote stations for wireless transmission via a central station 20. Schwartz discloses that remote stations may be directly connected to the central station 20 or through intermediate stations 28, where each intermediate station 28 may be connected to multiple remote stations 22. And further intermediate stations 28 may be connected to additional intermediate stations 28 to act as signal relays between central station 20 and remote stations 22. Such intermediate stations 28 enable topologies that "connect central station 20 directly to any number of intermediate stations 28 and/or remote stations 22." Ex. 1010, 4:33-38.

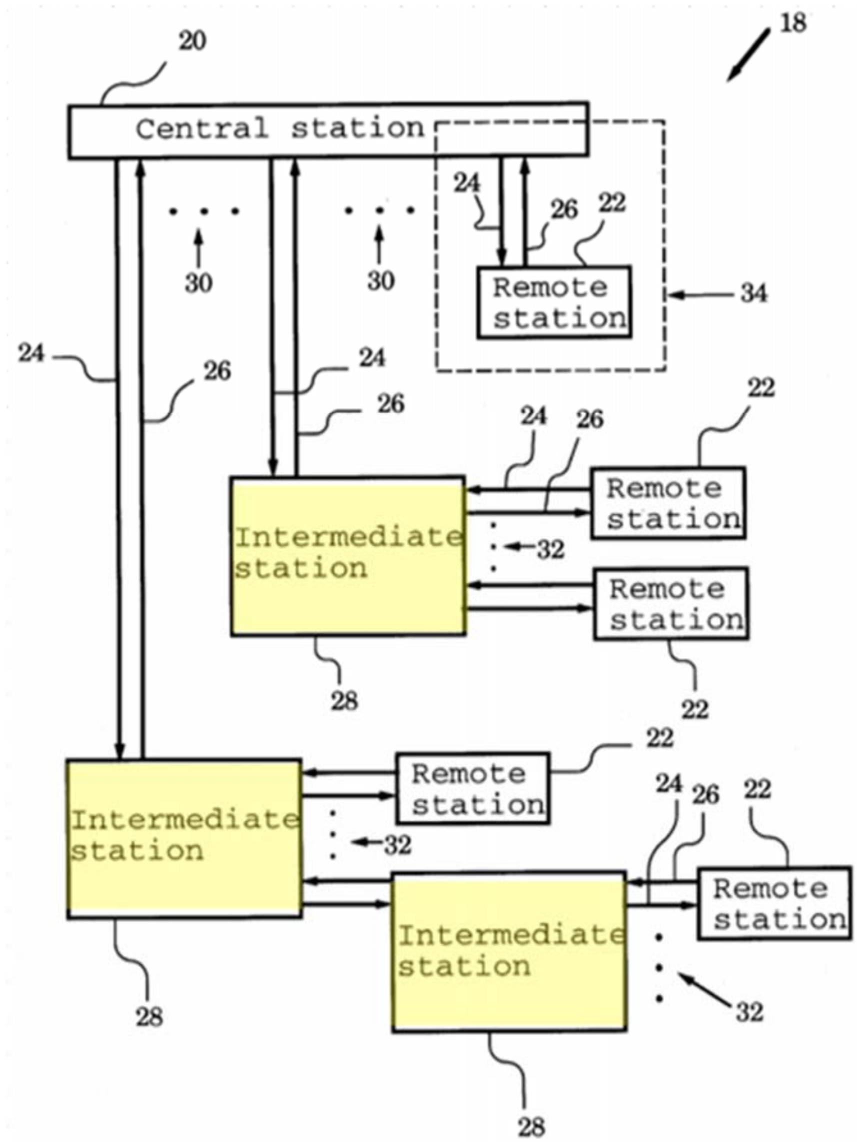


FIG. 1

As noted below, the remote stations highlighted in yellow are coupled to the host central station via a shared communication link highlighted in green.

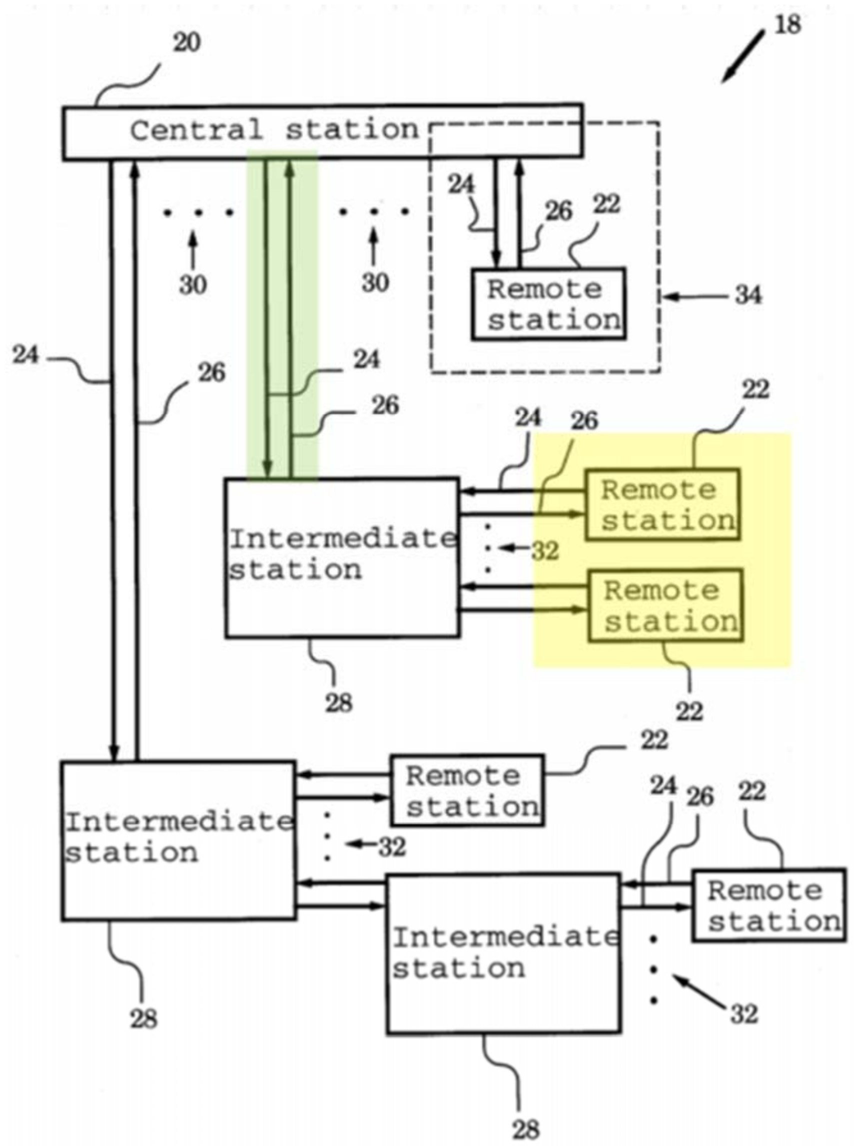


FIG. 1

As described above, a POSITA would have been motivated to incorporate Schwartz intermediate stations 28 into Oh's system to enable connection to more remote units (*e.g.*, slave units 30), where Oh's system was limited in the number of slave units 30 to which master unit 20 could be connected by master unit 20's optical ports (*e.g.*, four ports in Figs. 2 & 5). Thus Oh in view of Schwartz renders obvious at least some of the plurality of second units are communicatively coupled to the first unit at least in part using a shared wired communication link (green highlighted link above). Ex. 1005, ¶¶649-651.

3. Dependent Claim 4

Claim 4 recites "at least some of the plurality of second units are communicatively coupled to the first unit using an intermediary digital expansion unit." Schwartz discloses that remote stations may be directly connected to the central station 20 or through intermediate stations 28, where each intermediate station 28 may be connected to multiple remote stations 22. Such intermediate stations 28 enable topologies that "connect central station 20 directly to any number of intermediate stations 28 and/or remote stations 22." Ex. 1010, 4:33-38.

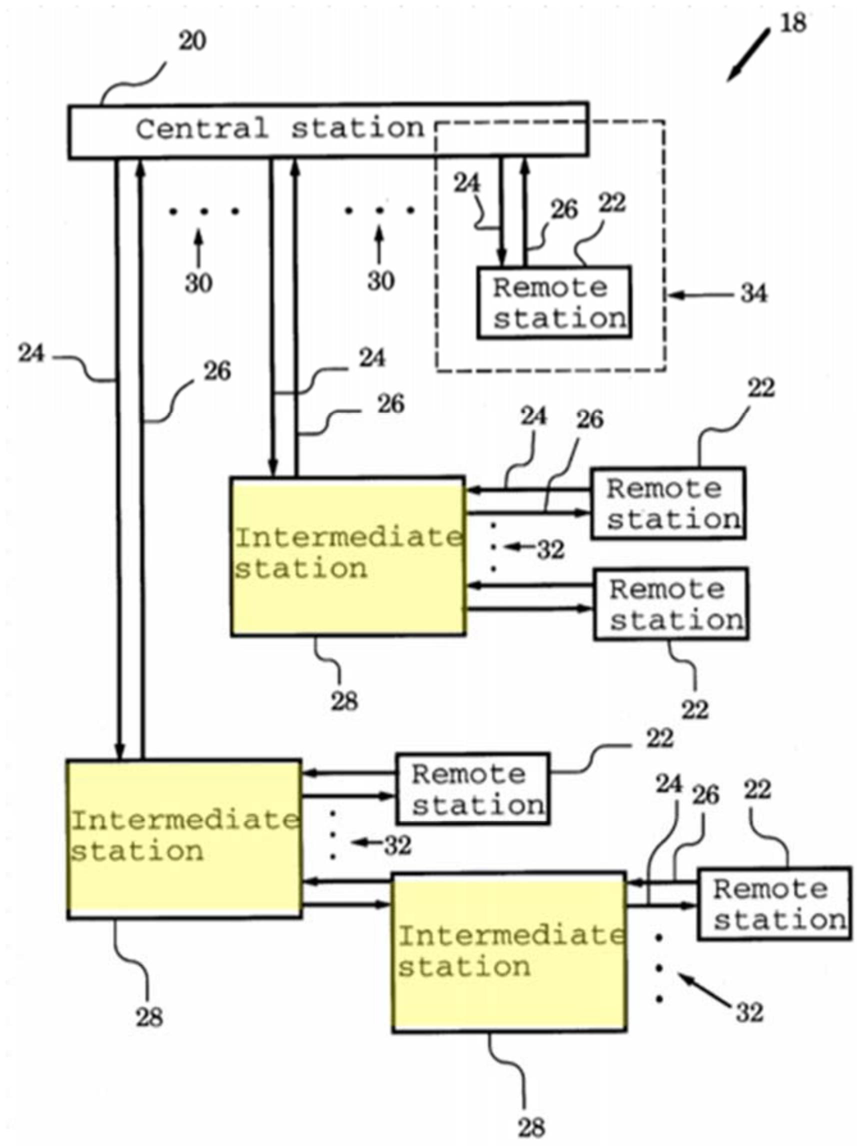


FIG. 1

Thus Oh in view of Schwarz renders obvious at least some of the plurality of second units (Oh 30; Schwartz 22) are communicatively coupled to the first unit (Oh 20, Schwartz 20) using an intermediary digital expansion unit (Schwartz 28). Ex. 1005, ¶¶652-653.

4. Dependent Claims 22, 23, 33, 34, 45, 46, 53, and 54

Dependent claims 22, 33, 45, and 53 are rendered obvious by Oh in view of

Schwartz for the reasons provided above for claim 3.

Dependent claims 23, 34, 46, and 54 are rendered obvious by Oh in view of Schwartz for the reasons provided above for claim 4. Ex. 1005, ¶654.

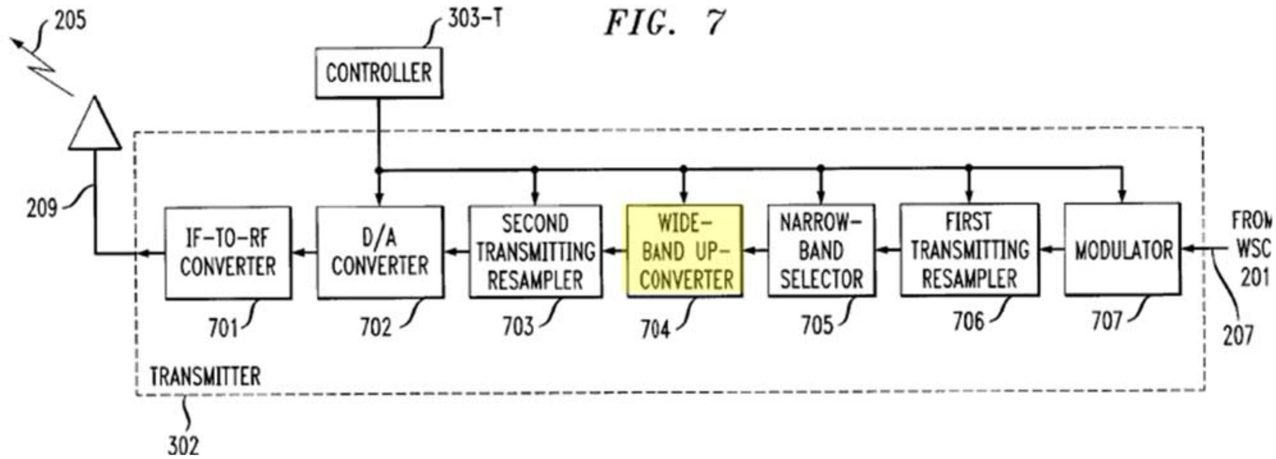
D. Ground 1c: Claims 8, 9, 26, 49, 50, and 57 are unpatentable under 35 U.S.C. § 103 over Oh in view of Allpress

1. Motivation to Combine

A POSITA would be motivated to combine the teachings of Allpress with Oh for a variety of reason. As noted in Allpress, implementation of software transceivers can offer a cost and complexity advantage over hardware implementations by avoiding the need for "duplicative hardware" that has associated expense and maintenance costs. Further, software transceivers are more portable to different systems, using different communications protocols, where software transceiver behavior can be modified through adjustment of software settings as opposed to replacement of physical hardware components. Thus a software transceiver is not "standards specific" and can be easily configured to the requirements of a current use case. Ex. 1005, ¶655.

2. Dependent Claim 8

Claim 8 recites "the system further comprises software configured to perform the base station processing using the input derived from the resulting summed digital samples." While Oh depicts a hardware implementation of its reverse master unit that performs "base station processing," a POSITA would consider implementation of some or all of Oh's post-summing (430) processing in software, where Allpress discloses a transmitter in Fig. 7 that provides upconversion 704 and other functions analogous to Oh's base station processing in software. Ex. 1021, 8:40-43.



Thus Oh in view of Allpress renders obvious the system further comprises software (*e.g.*, software upconversion and other functionality as disclosed in Allpress) configured to perform the base station processing using the input derived from the resulting summed digital samples (outputs of Oh 430). Ex. 1005, ¶¶656-657.

3. Dependent Claim 9

Claim 9 recites "the first unit comprises the software configured to perform the base station processing using the input derived from the resulting summed digital samples." As discussed above, Oh in view of Allpress renders obvious using software to perform certain of Oh's reverse master unit functionality depicted in Fig. 5. A POSITA would consider it obvious to implement that software functionality in Oh's master unit 20 (*i.e.*, the same location as Oh's hardware implementation).

Thus Oh in view of Allpress renders obvious the first unit (Oh, 20) comprises the software configured to perform the base station processing using the input derived from the resulting summed digital samples. Ex. 1005, ¶¶658-659.

4. Dependent Claims 26, 49, 50, and 57

Dependent claim 49 is rendered obvious by Oh in view of Allpress for the reasons provided above for claim 8.

Dependent claims 26, 50, and 57 are rendered obvious by Oh in view of Allpress for the reasons provided above for claim 9. Ex. 1005, ¶660.

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 ’402 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.

The ’402 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

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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.

VII. Conclusion

Petitioner therefore requests that the Patent Office order an IPR trial and then proceed to cancel the challenged claims.

Date: August 12, 2021

Respectfully submitted,

By: /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. 9,332,402, 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. 9,332,402, and the accompanying Declaration of Dr. R. Jacob Baker, was sent on August 12, 2021 to CommScope's litigation counsel via email to the following addresses:

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Date: August 12, 2021

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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 11,551 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

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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," Philip M. Wala ("Wala"),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”)