

**IN THE UNITED STATES DISTRICT COURT
FOR THE WESTERN DISTRICT OF TEXAS
MIDLAND DIVISION**

INTELLECTUAL VENTURES I LLC and	)	
INTELLECTUAL VENTURES II LLC,	)	
	)	
<i>Plaintiffs,</i>	)	C.A. No. 7:24-cv-00277-ADA
	)	
v.	)	
	)	JURY TRIAL DEMANDED
SOUTHWEST AIRLINES CO.,	)	
	)	
<i>Defendant.</i>	)	

**PLAINTIFFS' DISCLOSURE OF
PRELIMINARY INFRINGEMENT CONTENTIONS**

Pursuant to the Court's Standing Order Governing Proceedings ("OGP"), Plaintiffs Intellectual Ventures I LLC and Intellectual Ventures II LLC (collectively, "Intellectual Ventures," "IV," or "Plaintiffs"), hereby provides its Initial Infringement Contentions to Defendant Southwest Airlines Co. ("Southwest" or "Defendant") for United States Patent No. 8,332,844 ("the '844 Patent"), United States Patent No. 8,407,722 ("the '722 Patent"), United States Patent No. 7,949,785 ("the '785 Patent"), United States Patent No. 8,027,326 ("the '326 Patent"), United States Patent No. 7,324,469 ("the '469 Patent"), and United States Patent No. 7,257,582 ("the '582 Patent") (collectively, the "Asserted Patents" or "Patents-in-Suit").

IV makes this disclosure based on the information presently available to it. Discovery in this case has not started, and IV reserves its right to amend or supplement these disclosures as permitted by the Federal Rules of Civil Procedure, by the local rules of the Western District of Texas, and by order of the Court.

For each Asserted Patent, Plaintiffs identify the following Accused Instrumentalities of which it is currently aware. The identification of Accused Instrumentalities is based on Plaintiffs' research and analysis to date, without the benefit of discovery from the Defendant. Plaintiffs

reserve the right to add, delete, substitute or otherwise amend this list of Accused Instrumentalities based on discovery or other circumstances, in a manner consistent with the Federal Rules of Civil Procedures, local rules, and standing order.

The Accused Instrumentalities include, without limitation, the following:

- '844 Patent. The Accused Instrumentalities include, without limitation, Southwest systems that utilize Docker, and all past, current and future Southwest products that operate in the same or substantially similar manner as the specifically identified products and components, and all past, current and future Southwest products that have the same or substantially similar features as the specifically identified products and components provided in Exhibit 1.
- '722 Patent. The Accused Instrumentalities include, without limitation, Southwest systems that utilize Kafka, and all past, current and future Southwest products that operate in the same or substantially similar manner as the specifically identified products and components, and all past, current, and future Southwest products that have the same or substantially similar features as the specifically identified products and components provided in Exhibit 2.
- '785 Patent. The Accused Instrumentalities include, without limitation, Southwest systems that utilize Kubernetes, and all past, current and future Southwest products that operate in the same or substantially similar manner as the specifically identified products and components, and all past, current and future Southwest products that have the same or substantially similar features as the specifically identified products and components provided in Exhibit 3.
- '326 Patent. The Accused Instrumentalities include, without limitation, Southwest systems that provide Wi-Fi Access Points that support at least IEEE 802.11n and/or 802.11ac, and all past, current, and future Southwest products that operate in the same or substantially similar manner as the specifically identified products and components, and all past, current and future Southwest products that have the same or substantially similar features as the specifically identified products and components. Exhibit 4.
- '469 Patent. The Accused Instrumentalities include, without limitation, Southwest systems that provide satellite-based onboard WiFi, and all past, current and future Southwest products that operate in the same or substantially similar manner as the specifically identified products and components, and all past, current and future Southwest products that have the same or substantially similar features as the specifically identified products and components. Exhibit 5.
- '582 Patent. The Accused Instrumentalities include, without limitation, Southwest systems that utilize Hadoop and/or Spark, and all past, current and future Southwest products that operate in the same or substantially similar manner as the specifically identified products and components, and all past, current and future Southwest products that have the same or substantially similar features as the specifically identified products and components provided in Exhibits 6 and 7.
- All past, current and future Southwest products and services that operate in the same or substantially similar manner as the specifically identified products and services above and

described in Exhibits 1-7 (claim charts identifying specifically where each element of each asserted claim is found within each Accused Instrumentality).

- All past, current and future Southwest products and services that have the same or substantially similar features as the specifically identified products and services above and described in Exhibits 1-7, (claim charts identifying specifically where each element of each asserted claim is found within each Accused Instrumentality).

Plaintiffs' infringement contentions apply to the Accused Instrumentalities as well as all other past, current and future hardware and software products and services developed, made, used, offered for sale, sold, imported, and provided by Southwest that contain or make use of the Patented Technology.¹ This identification of Accused Instrumentalities is based upon Plaintiffs' diligent investigation to date, and without the benefit of any discovery from the Defendant and without the benefit of the Court's claim construction. Plaintiffs expressly reserve the right to add, delete, substitute or otherwise amend this list of Accused Instrumentalities based on discovery, the Court's claim construction, or other circumstances, in a manner consistent with the Federal Rules of Civil Procedure and the Court's rules, including the local Patent Rules.

These preliminary infringement contentions are based upon publicly available information and Plaintiffs' diligent investigation to date, and without the benefit of any substantial discovery from the Defendant and without the benefit of the Court's claim construction. Plaintiffs anticipate that discovery may provide additional evidence of Defendant's infringement, may lead to the discovery of additional instances of infringement, and may also enable identification of additional claims that are infringed by Defendant.

Based upon currently available information, IV asserts that Southwest has infringed and/or continues to infringe the patents and claims identified in the attached claim charts (the "Asserted Claims" of the Patents-in-Suit). Infringement claim charts evidencing the correspondence between (i) the elements of the Asserted Claims, and (ii) the corresponding items of the Accused

¹ "Patented Technology" means all technologies described in the claims of the Patents-in-Suit.

Instrumentalities are attached hereto. Further, Exhibits 1-7, which are attached hereto and incorporated by reference, are exemplary infringement claim charts identifying specifically where each limitation of each Asserted Claim is found within each Accused Instrumentality or practiced by each Accused Instrumentality.

Plaintiffs assert that Defendant has directly infringed and continues to directly infringe the Asserted Claims literally through the Accused Instrumentalities by making, using, offering for sale, selling, and/or importing into the United States the Accused Instrumentalities. To the extent that Defendant alleges that one or more limitations of the Asserted Claims are not literally found in the Accused Instrumentalities, Plaintiffs allege that such limitations are found in or practiced by the Accused Instrumentalities under the doctrine of equivalents. Any differences alleged to exist between any of the Asserted Claims and any of the Accused Instrumentalities are insubstantial and that each Accused Instrumentality also meets each limitation under the doctrine of equivalents as the identified features of the Accused Instrumentality performs substantially the same function in substantially the same way to achieve substantially the same result as the corresponding claim limitation. IV reserves the right to assert infringement solely under the doctrine of equivalents with respect to any particular claim element(s), if warranted by discovery, further analysis, and/or claim constructions in this case.

These assertions are based upon Plaintiffs' diligent investigation to date, and without the benefit of any substantial discovery from the Defendant and without the benefit of the Court's claim construction. Plaintiffs reserve the right to add, delete, substitute or otherwise amend these infringement allegations based on discovery, the Court's claim construction, or other circumstances, in a manner consistent with the Federal Rules of Civil Procedure and the Court's rules, including the local Patent Rules.

Plaintiffs further assert that Defendant has indirectly infringed and continues to indirectly infringe by actively inducing infringement of one or more of the claims of the Asserted Patents through the Accused Instrumentalities. *See Exhibits 1-7.*

Plaintiffs also assert that these third parties directly infringe at least one or more of the claims of the Asserted Patents through the manufacture, use, sale, offer to sell, or importation of the Accused Instrumentalities. *See Exhibits 1-7.*

For example, Defendant has actively induced infringement by encouraging the use of the Accused Instrumentalities in ways that infringe each Asserted Claim. Defendant knew or should have known that such encouragement would induce infringement. Defendant has taken active steps with the specific intent to encourage and cause others to use each Accused Instrumentality in ways that infringes each Asserted Claim. Such active steps by Defendant with specific intent to induce infringement have included, among other things, advertising, promoting, marketing, making available for use, offering to sell, and/or selling the Accused Instrumentalities to others; encouraging and influencing others to import, offer to sell, and/or sell the Accused Instrumentalities; directing and instructing others to use the Accused Instrumentalities in infringing ways, including providing and promoting the described hardware and/or software components and features that when used in their normal and customary ways as intended and designed; and by providing the Accused Instrumentalities to others. Southwest has performed the aforementioned steps with the knowledge of the Asserted Patents through receipt of a letter dated September 30, 2024, and received by Defendant on the same date, and also as of the date when the complaint in this case was filed. Southwest has known or should have known that the acts it has induced constitute infringement because, for instance, it has been aware that its customers, employees, and/or third parties, such as vendors, will use the Accused Instrumentalities, resulting in direct infringement.

IV further reserves the right to supplement or revise its infringement contentions and/or charts. Such supplement may be based upon, for example, further discovery. Further, IV reserves the right to supplement or revise its infringement contentions and/or chart(s), including identification of additional asserted claims, based on, for example, new versions or variations of one or more of the accused products that are later discovered.

The Asserted Claims of the Patents in Suit are entitled to at least the priority dates identified below:

- Each of the Asserted Claims of the '844 Patent is entitled to a priority date of no later than December 30, 2004.
- Each of the Asserted Claims of the '722 Patent is entitled to a priority date of no later than December 18, 2000.
- Each of the Asserted Claims of the '785 Patent is entitled to a priority date of no later than March 21, 2003.
- Each of the Asserted Claims of the '326 Patent is entitled to a priority date of no later than January 12, 2004.
- Each of the Asserted Claims of the '469 Patent is entitled to a priority date of no later than September 29, 2003.
- Each of the Asserted Claims of the '582 Patent is entitled to a priority date of no later than March 13, 2002.

The subject matter described by the Asserted Claims may have been conceived and reduced to practice prior to these dates. Plaintiffs' research and analysis is ongoing, and Plaintiffs reserve the right to assert that the claims are entitled to a priority date that is earlier than the above dates.

Dated: February 10, 2025

Respectfully submitted,

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Attorneys for Plaintiffs
INTELLECTUAL VENTURES I LLC and
INTELLECTUAL VENTURES II LLC

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing instrument was served or delivered electronically, via email, to all counsel of record, on this 10th day of February 2025.

/s/ Jonathan K. Waldrop
Jonathan K. Waldrop

**Exhibit 4 to
Intellectual Ventures I LLC's and Intellectual Ventures II LLC's
Preliminary Infringement Contentions**

**Infringement Claim Chart of
U.S. Patent No. 8,027,326 (“’326 Patent”)**

The Accused Systems and Services include without limitation Southwest systems and services that provide Wi-Fi Access Points that support at least IEEE 802.11n and/or 802.11ac; all past, current, and future systems and services that operate in the same or substantially similar manner as the specifically identified systems and services; and all past, current, and future Southwest systems and services that have the same or substantially similar features as the specifically identified systems and services (“Example Southwest Count 4 Systems and Services” or “Southwest Systems and Services”).¹

On information and belief, Southwest’s Systems and Services directly infringe the asserted claims of the ’326 patent, either literally or under the doctrine of equivalents, through at least using IEEE 802.11n and/or 802.11ac WiFi in its airplanes. In addition, Southwest directly infringes the ’326 patent by testing the Southwest Systems and Services. On information and belief, Southwest, with knowledge at least since the time of filing the complaint, also indirectly infringes the ’326 Patent by inducing its employees and customers to use Southwest Systems and Services, and provides documents that include instructions regarding how to use Southwest Systems and Services in an infringing manner. On information and belief, Southwest provides instructions on how to use the Southwest Systems and Services in an infringing manner, the use of which results in infringement of the ’326 Patent claims. On information and belief, Southwest also indirectly infringes by contributorily infringing the ’326 Patent by selling, offering to sell, or importing components used in the Southwest Systems and Services that do not have substantial non-infringing uses.

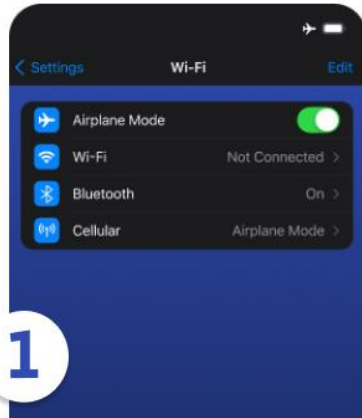
Consistent with this Court’s Standing Order Governing Proceedings (OGP), IV identifies systems and services that provide Wi-Fi Access Points that support at least IEEE 802.11n and/or 802.11ac, as used in Southwest’s systems and offerings, as the Accused Instrumentality. Information regarding how specifically Southwest implements WiFi, including for which products and offerings, is generally not public. IV intends to obtain discovery regarding how WiFi is used and implemented in Southwest products and services and will update its infringement positions once this discovery is completed.

¹ IV understands that ViaSat Inc. (ViaSat) and Anuvu Corp. (Anuvu) has alleged that IV has exhausted any rights to pursue any infringement claims under the ’326 Patent due to patent exhaustion. *See generally* Case No. DDE-1-25-cv-00056, Dkt. 1 at ¶¶ 48, 51; Case No. DDE-1-25-cv-00124, Dkt. 1 at ¶¶ 48, 52. As of the date of these preliminary infringement contentions, IV has not yet responded to ViaSat and Anuvu’s contentions. IV is investigating the contentions made by ViaSat and Anuvu, including the relationship between IV’s infringement contentions relating to the ’326 Patent and hardware and/or software used by the Southwest Systems and Services. Discovery has not begun in this matter. To the extent Southwest contends that a license exists for some or all of the Southwest Systems and Services for the entire applicable damages period, IV will meet and confer with Southwest to better understand such contentions, and will continue to investigate ViaSat and Anuvu’s contentions.

IV does not intend this exemplary claim chart to be limiting, and IV reserves its rights to pursue other accused instrumentalities, patent claims, evidence, and infringement arguments in this case. Discovery has yet to begin, and this case is still in its initial stages. Accordingly, IV reserves the right to amend and/or supplement these contentions to the full extent allowed by the Court, including but not limited to, incorporating additional information, claims, theories, and / or accused products.

On information and belief, the Southwest Systems and Services provide Wi-Fi Access Points that enable Internet connectivity on its airplanes.

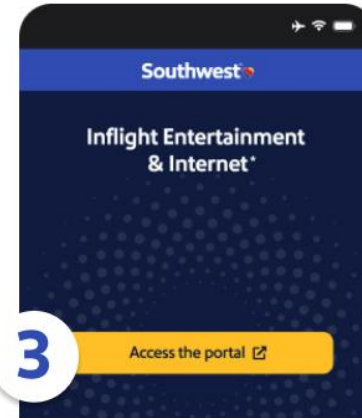
How to Get Connected ^



Head to **Settings**.
Turn on Airplane mode.



Turn on Wi-Fi.
Choose **SouthwestWiFi** from the WiFi network list.



Tap Access the portal or open
SouthwestWiFi.com in your browser directly.

Source: <https://www.southwest.com/inflight-entertainment-portal/>.²

We're excited to announce that as of yesterday, March 9, 2023, our first aircraft equipped with hardware from our new WiFi vendor, Viasat, has entered service. Viasat is an industry leader, and we're excited about the increased connectivity and reliability that Viasat will provide. As we prepare for additional Viasat-equipped aircraft deliveries, we're also making significant progress updating our existing fleet with new Anuvu hardware (our original WiFi vendor). We have now upgraded more than 400 aircraft and are well on our way to upgrading the entire fleet by the third quarter of this year.

Between our upgraded Anuvu hardware and integration of Viasat, we're bringing a faster, more reliable WiFi experience. In addition to improved WiFi quality, Viasat offers Customers the ability to trade paid internet connectivity between personal devices (known as "device swapping"). For example, if a Customer has paid for Internet using their laptop, they can use the "swap device" function in the Inflight Entertainment Portal to switch connectivity to their phone.

² All sources cited in this document were publicly accessible as of the filing date of the Complaint.

	Anuvu Legacy	Anuvu Upgraded	Viasat
Improved Speeds and Reliability	✗	✓	✓
Streaming (when authenticated for Internet)	✗	✓	✓
Device Swap	✗	✗	✓
Free Entertainment, Texting, and Flight Tracker	✓	✓	✓

Source: <https://www.swamedia.com/southwest-stories/wifi-modernization-first-viasat-aircraft-enters-service-MC5XTXWTTLWNESJDQR4LZQBID2I>.

On information and belief, Southwest uses routers that support WiFi 802.11 ac/abgn, such as the Viasat Select Router.

Viasat Select Router

Redefining the in-flight connectivity experience

The Viasat Select Router, coupled with Viasat's latest generation satellite terminal, delivers a fully managed internet connectivity network inside the cabin that promises to deliver maximum speed and capabilities from Viasat's high-capacity satellite network.

Source: https://www.viasat.com/content/dam/us-site/aviation/documents/Viasat_Select_Router-datasheet.pdf.

Multi-link connections

The Viasat Select Router ("VSR") is a fully featured cabin connectivity management device that integrates the Viasat connectivity service with other available cabin connectivity on the aircraft. User traffic is routed automatically over the best available network and in the event of a service disruption, an alternate service is automatically selected to ensure continuous internet access.

Every VSR is equipped with an integral cellular modem that enables near global 4G LTE data service while the aircraft is on the ground. The data service can be used by passengers or crew, and is available to Viasat's technical support team for remote access to assist with equipment configuration, software updates, and other troubleshooting support, while the aircraft remains in the hangar.

The router incorporates an 802.11ac Wi-Fi access point for easy in-cabin wireless connectivity for passengers, crew and ground operations. Additional antennas can be added to ensure optimal signal strength inside the cabin as necessary.

Source: https://www.viasat.com/content/dam/us-site/aviation/documents/Viasat_Select_Router-datasheet.pdf.

SPECIFICATIONS			
Size	1.75 in. H x 7.8 in. W x 5.5 in. D	Storage	1 TB (OS and applications)
Weight	3.9 lbs	Ethernet Ports	› 5 x 10/100/1000 bps Ethernet Ports (Switched) › 1 x 10/100/1000 bps Ethernet Ports (Direct) › 1 x 10/100/1000 bps Ethernet Ports (Front Panel)
Voltage	28VDC with 200ms Hold-up	ARINC 429	2x Rx Channels / 1x Tx Channel
Power	20W(typical); 30W (max)	Cellular Modem	Integrated Global coverage 4G/LTE Advanced modem; 2x mini SIMs; 2x RF QMA connections
Environment	Qualified to DO-160G	Wi-Fi	802.11 ac/abgn; 3x RF QMA connections
Processor	Intel E3845 4 Core processor, 1.5GHz		

Source: https://www.viasat.com/content/dam/us-site/aviation/documents/Viasat_Select_Router-datasheet.pdf.

IEEE 802.11n™, or Wi-Fi 4, was introduced in 2009 to support the 2.4 GHz and 5GHz frequency bands, with up to 600 Mbit/s data rates, multiple channels within each frequency band, and other features. IEEE 802.11n data throughputs enabled the use of WLAN networks in place of wired networks, a significant feature enabling new use cases and reduced operational costs for end users and IT organizations.

IEEE 802.11ac™, or Wi-Fi 5, was introduced in 2013 to support data rates at up to 3.5 Gbit/s, with still-greater bandwidth, additional channels, better modulation, and other features. It was the first Wi-Fi standard to enable the use of multiple input/multiple output (MIMO) technology so that multiple antennas could be used on both sending and receiving devices to reduce errors and boost speed.

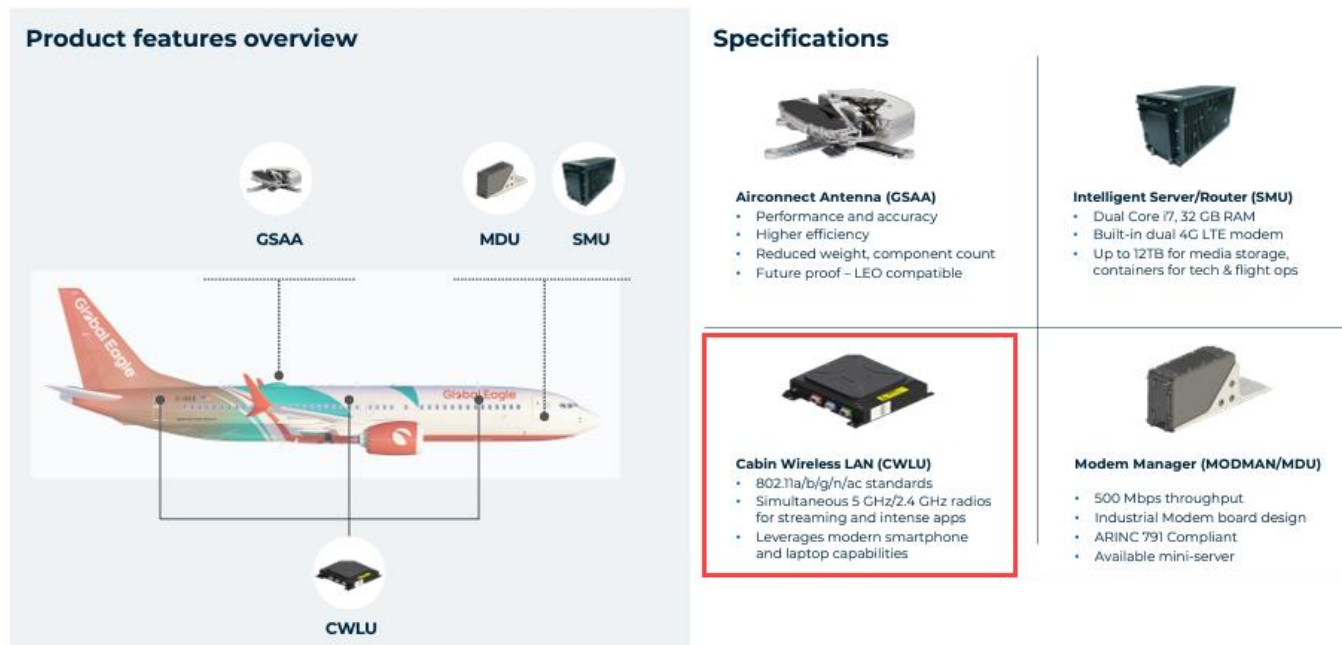
Source: <https://standards.ieee.org/beyond-standards/the-evolution-of-wi-fi-technology-and-standards/>.

On information and belief, other Southwest In-Flight Connectivity (IFC) providers, such as Anuvu, support IEEE 802.11n and 802.11ac.

Satellite-based Connectivity and Entertainment experience

- High-speed internet and content streaming
- Consistent connected service with optimized network coverage
- Tiered payment configuration
- Ancillary revenue models
- Entertainment delivered as fully licensed and industry compliant
- Line-fit and retro-fit installation options
- No-touch software and content updates
- Flying onboard over 1,000+ aircraft

Direct to passenger's own device connectivity and entertainment inflight experience



Source:

https://d1io3yog0oux5.cloudfront.net/anuvu/files/pages/anuvu/db/620/description/AirconnectGlobalKU_Final_ProductSheet+.pdf.

U.S. Patent No. 8,027,326 (Claim 1)																							
Claim(s)	Example Southwest Count 4 Systems and Services																						
[1.pre] A method for increasing data rates and data throughput in a network, the method comprising:	To the extent this preamble is limiting, on information and belief, the Southwest Count 4 Systems and Services practice a method for increasing data rates and data throughput in a network. On information and belief, Southwest provides in flight Wi-Fi connectivity through provider equipment provided by at least Viasat and Anuvu. This equipment is compliant with Wi-Fi 802.11n and 802.11ac protocols. For example, the Viasat equipment and Anuvu equipment is compliant with the Wi-Fi 802.11n and 802.11ac protocols. We're excited to announce that as of yesterday, March 9, 2023, our first aircraft equipped with hardware from our new WiFi vendor, Viasat, has entered service. Viasat is an industry leader, and we're excited about the increased connectivity and reliability that Viasat will provide. As we prepare for additional Viasat-equipped aircraft deliveries, we're also making significant progress updating our existing fleet with new Anuvu hardware (our original WiFi vendor). We have now upgraded more than 400 aircraft and are well on our way to upgrading the entire fleet by the third quarter of this year. Between our upgraded Anuvu hardware and integration of Viasat, we're bringing a faster, more reliable WiFi experience. In addition to improved WiFi quality, Viasat offers Customers the ability to trade paid internet connectivity between personal devices (known as "device swapping"). For example, if a Customer has paid for Internet using their laptop, they can use the "swap device" function in the Inflight Entertainment Portal to switch connectivity to their phone. <table><thead><tr><th></th><th>Anuvu Legacy</th><th>Anuvu Upgraded</th><th>Viasat</th></tr></thead><tbody><tr><td>Improved Speeds and Reliability</td><td>✗</td><td>✓</td><td>✓</td></tr><tr><td>Streaming (when authenticated for Internet)</td><td>✗</td><td>✓</td><td>✓</td></tr><tr><td>Device Swap</td><td>✗</td><td>✗</td><td>✓</td></tr><tr><td>Free Entertainment, Texting, and Flight Tracker</td><td>✓</td><td>✓</td><td>✓</td></tr></tbody></table> Source: https://www.swamedia.com/southwest-stories/wifi-modernization-first-viasat-aircraft-enters-service-MC5XTXWTTLWNESJDQR4LZQBIDI2I.				Anuvu Legacy	Anuvu Upgraded	Viasat	Improved Speeds and Reliability	✗	✓	✓	Streaming (when authenticated for Internet)	✗	✓	✓	Device Swap	✗	✗	✓	Free Entertainment, Texting, and Flight Tracker	✓	✓	✓
	Anuvu Legacy	Anuvu Upgraded	Viasat																				
Improved Speeds and Reliability	✗	✓	✓																				
Streaming (when authenticated for Internet)	✗	✓	✓																				
Device Swap	✗	✗	✓																				
Free Entertainment, Texting, and Flight Tracker	✓	✓	✓																				

U.S. Patent No. 8,027,326 (Claim 1)

Claim(s)

Example Southwest Count 4 Systems and Services

Viasat Select Router

Redefining the in-flight connectivity experience

The Viasat Select Router, coupled with Viasat's latest generation satellite terminal, delivers a fully managed internet connectivity network inside the cabin that promises to deliver maximum speed and capabilities from Viasat's high-capacity satellite network.

Source: https://www.viasat.com/content/dam/us-site/aviation/documents/Viasat_Select_Router-datasheet.pdf.

SPECIFICATIONS

Size	1.75 in. H x 7.8 in. W x 5.5 in. D	Storage	1 TB (OS and applications)
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Power	20W(typical); 30W (max)	Cellular Modem	Integrated Global coverage 4G/LTE Advanced modem; 2x mini SIMs; 2x RF QMA connections
Environment	Qualified to DO-160G	Wi-Fi	802.11 ac/abgn; 3x RF QMA connections
Processor	Intel E3845 4 Core processor, 1.5GHz		

Source: https://www.viasat.com/content/dam/us-site/aviation/documents/Viasat_Select_Router-datasheet.pdf.

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	Satellite-based Connectivity and Entertainment experience • High-speed internet and content streaming • Entertainment delivered as fully licensed and industry compliant • Consistent connected service with optimized network coverage • Line-fit and retro-fit installation options • Tiered payment configuration • No-touch software and content updates • Ancillary revenue models • Flying onboard over 1,000+ aircraft Direct to passenger's own device connectivity and entertainment inflight experience

U.S. Patent No. 8,027,326 (Claim 1)

Claim(s)	Example Southwest Count 4 Systems and Services
	Product features overview  The diagram shows a Global Eagle aircraft with four components labeled: GSAA (Global Satellite Antenna Array) on the tail, MDU (Modem Data Unit) on the fuselage, SMU (Smart Modem Unit) on the fuselage, and CWLU (Cabin Wireless LAN Unit) on the fuselage. Lines connect these components to their respective descriptions in the Specifications section. Specifications  Airconnect Antenna (GSAA) • Performance and accuracy • Higher efficiency • Reduced weight, component count • Future proof – LEO compatible  Intelligent Server/Router (SMU) • Dual Core i7, 32 GB RAM • Built-in dual 4G LTE modem • Up to 12TB for media storage, containers for tech & flight ops  Cabin Wireless LAN (CWL) • 802.11a/b/g/n/ac standards • Simultaneous 5 GHz/2.4 GHz radios for streaming and intense apps • Leverages modern smartphone and laptop capabilities  Modem Manager (MODMAN/MDU) • 500 Mbps throughput • Industrial Modem board design • ARINC 791 Compliant • Available mini-server

Source:

https://d1io3yog0oux5.cloudfront.net/anuvu/files/pages/anuvu/db/620/description/AirconnectGlobalKU_Final_ProductSheet+.pdf.

On information and belief, by bonding two 20 MHz channels together, the IEEE 802.11-2016 standard enables 40 MHz capable high throughput (HT) operation, which can support high data rates up to 600 Mb/s.

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	3A. Definitions specific to IEEE 802.11 The following terms and definitions are specific to this standard and are not appropriate for inclusion in the <i>IEEE Standards Dictionary: Glossary of Terms & Definitions</i>.¹ 3A.1 20 MHz basic service set (BSS): A BSS in which the Secondary Channel Offset field is set to SCN. 3A.2 20 MHz high-throughput (HT): A Clause 20 transmission using FORMAT=HT_MF or HT_GF and CH_BANDWIDTH=HT_CBW20. 3A.3 20 MHz mask physical layer convergence procedure (PLCP) protocol data unit (PPDU): A Clause 17 PPDU, a Clause 19 orthogonal frequency division multiplexing (OFDM) PPDU, or a Clause 20 20 MHz high-throughput (HT) PPDU with the TXVECTOR parameter CH_BANDWIDTH set to HT_CBW20 and the CH_OFFSET parameter set to CH_OFF_20. The PPDU is transmitted using a 20 MHz transmit spectral mask defined in Clause 17, Clause 19, or Clause 20, respectively. 3A.4 20 MHz physical layer convergence procedure (PLCP) protocol data unit (PPDU): A Clause 15 PPDU, Clause 17 PPDU, Clause 18 PPDU, Clause 19 orthogonal frequency division multiplexing (OFDM) PPDU, or Clause 20 20 MHz high-throughput (HT) PPDU with the TXVECTOR parameter CH_BANDWIDTH set to HT_CBW20.

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	3A.5 20/40 MHz basic service set (BSS): A BSS in which the supported channel width of the access point (AP) or independent BSS (IBSS) dynamic frequency selection (DFS) owner (IDO) station (STA) is 20 MHz and 40 MHz (Channel Width field is set to 1) and the Secondary Channel Offset field is set to a value of SCA or SCB. 3A.6 40-MHz-capable (FC) high-throughput (HT) access point (AP): An HT AP that included a value of 1 in the Supported Channel Width Set subfield (indicating its capability to operate on a 40 MHz channel) of its most recent transmission of a frame containing an HT Capabilities element. 3A.7 40-MHz-capable (FC) high-throughput (HT) access point (AP) 2G4: An HT AP 2G4 that is also an FC HT AP. 3A.8 40-MHz-capable (FC) high-throughput (HT) access point (AP) 5G: An HT AP 5G that is also an FC HT AP. 3A.9 40-MHz-capable (FC) high-throughput (HT) station (STA): An HT STA that included a value of 1 in the Supported Channel Width Set subfield (indicating its capability to operate on a 40 MHz channel) of its most recent transmission of a frame containing an HT Capabilities element. 3A.10 40-MHz-capable (FC) high-throughput (HT) station (STA) 2G4: An HT STA 2G4 that is also an FC HT STA. 3A.11 40-MHz-capable (FC) high-throughput (HT) station (STA) 5G: An HT STA 5G that is also an FC HT STA. 3A.12 40 MHz high throughput (HT): A Clause 20 transmission using FORMAT=HT_MF or HT_GF and CH_BANDWIDTH=HT_CBW40. Source: IEEE Standard 802.11n-2009 at 3-4.

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	3.2 Definitions specific to IEEE Std 802.11 20/40 MHz basic service set (BSS): A BSS in which the supported channel width of the access point (AP) or dynamic frequency selection (DFS) owner (DO) station (STA) is 20 MHz and 40 MHz (Channel Width field is equal to 1) and the Secondary Channel Offset field is equal to a value of secondary channel above (SCA) or secondary channel below (SCB). 40-MHz-capable (40MC) high-throughput (HT) access point (AP): An HT AP that included a value of 1 in the Supported Channel Width Set subfield (indicating its capability to operate on a 40 MHz channel) of its most recent transmission of a frame containing an HT Capabilities element. Source: IEEE Standard 802.11-2016 at 143.

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	20. High Throughput (HT) PHY specification 20.1 Introduction 20.1.1 Introduction to the HT PHY Clause 20 specifies the PHY entity for a high throughput (HT) orthogonal frequency division multiplexing (OFDM) system. In addition to the requirements found in Clause 20, an HT STA shall be capable of transmitting and receiving frames that are compliant with the mandatory PHY specifications defined as follows: — In Clause 17 when the HT STA is operating in a 20 MHz channel width in the 5 GHz band — In Clause 18 and Clause 19 when the HT STA is operating in a 20 MHz channel width in the 2.4 GHz band The HT PHY is based on the OFDM PHY defined in Clause 17, with extensibility up to four spatial streams, operating in 20 MHz bandwidth. Additionally, transmission using one to four spatial streams is defined for operation in 40 MHz bandwidth. These features are capable of supporting data rates up to 600 Mb/s (four spatial streams, 40 MHz bandwidth). Source: IEEE Standard 802.11n-2009 at 247. 19. High-throughput (HT) PHY specification 19.1 Introduction 19.1.1 Introduction to the HT PHY

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	The HT PHY is based on the OFDM PHY defined in Clause 17, with extensibility up to four spatial streams, operating in 20 MHz bandwidth. Additionally, transmission using one to four spatial streams is defined for operation in 40 MHz bandwidth. These features are capable of supporting data rates up to 600 Mb/s (four spatial streams, 40 MHz bandwidth). Source: IEEE Standard 802.11-2016 at 2334. 40MHz OFDM 802.11n • 802.11n also introduced a 40 MHz channel, which combined two 20 MHz channels • The 40 MHz channel consists of 128 subcarriers: • 128 subcarriers: • 108 transmit data subcarriers • 6 as pilot carriers • 14 unused

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	• When two 20 MHz HT channels are bonded together, some of the formerly unused subcarriers at the bottom of the higher channel and at the top end of the lower channel are able to be used to transmit data. • That is why the number of subcarriers is slightly more than two times the 56 subcarriers in a 20 MHz channel. • Each bonded channel consists of a primary and secondary 20 MHz channel. • The channels must be adjacent. A positive or negative offset indicates whether the secondary channel is the channel above or the channel below the primary channel. This is pictured in Figure 19.4. Source: https://dot11ap.wordpress.com/ht-channel-width-operation/. On information and belief, IEEE 802.11ac infringes for the same reasons as 802.11n. <i>See supra. See also:</i> 4.3.14 Very high throughput (VHT) STA The IEEE 802.11 VHT STA operates in frequency bands below 6 GHz excluding the 2.4 GHz band. A VHT STA is an HT STA that, in addition to features supported as an HT STA, supports VHT features identified in Clause 9, Clause 10, Clause 11, Clause 14, Clause 17, and Clause 21. The main PHY features in a VHT STA that are not present in an HT STA are the following: — Mandatory support for 40 MHz and 80 MHz channel widths — Mandatory support for VHT single-user (SU) PPDU — Optional support for 160 MHz and 80+80 MHz channel widths — Optional support for VHT sounding protocol to support beamforming — Optional support for VHT multi-user (MU) PPDU — Optional support for VHT-MCSs 8 and 9

U.S. Patent No. 8,027,326 (Claim 1)

Claim(s)

Example Southwest Count 4 Systems and Services

Source: IEEE Standard 802.11-2016 at 197.

Table 21-38—VHT-MCSs for mandatory 40 MHz, $N_{SS} = 1$

VHT-MCS Index	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)	
									800 ns GI	400 ns GI (See NOTE)
0	BPSK	1/2	1	108	6	108	54	1	13.5	15.0
1	QPSK	1/2	2	108	6	216	108	1	27.0	30.0
2	QPSK	3/4	2	108	6	216	162	1	40.5	45.0
3	16-QAM	1/2	4	108	6	432	216	1	54.0	60.0
4	16-QAM	3/4	4	108	6	432	324	1	81.0	90.0
5	64-QAM	2/3	6	108	6	648	432	1	108.0	120.0
6	64-QAM	3/4	6	108	6	648	486	1	121.5	135.0
7	64-QAM	5/6	6	108	6	648	540	1	135.0	150.0
8	256-QAM	3/4	8	108	6	864	648	1	162.0	180.0
9	256-QAM	5/6	8	108	6	864	720	1	180.0	200.0

NOTE—Support of 400 ns GI is optional on transmit and receive.

See also IEEE Standard 802.11-2016 at 2612, where a 40 MHz Modulation and Coding Scheme (MCS) is mandatory.

U.S. Patent No. 8,027,326 (Claim 1)

Claim(s)

Example Southwest Count 4 Systems and Services

Table 21-46—VHT-MCSs for mandatory 80 MHz, $N_{SS} = 1$

VHT-MCS Index	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBP_S}	N_{DBPS}	N_{ES}	Data rate (Mb/s)	
									800 ns GI	400 ns GI (See NOTE)
0	BPSK	1/2	1	234	8	234	117	1	29.3	32.5
1	QPSK	1/2	2	234	8	468	234	1	58.5	65.0
2	QPSK	3/4	2	234	8	468	351	1	87.8	97.5
3	16-QAM	1/2	4	234	8	936	468	1	117.0	130.0
4	16-QAM	3/4	4	234	8	936	702	1	175.5	195.0
5	64-QAM	2/3	6	234	8	1404	936	1	234.0	260.0
6	64-QAM	3/4	6	234	8	1404	1053	1	263.3	292.5
7	64-QAM	5/6	6	234	8	1404	1170	1	292.5	325.0
8	256-QAM	3/4	8	234	8	1872	1404	1	351.0	390.0
9	256-QAM	5/6	8	234	8	1872	1560	1	390.0	433.3

NOTE—Support of 400 ns GI is optional on transmit and receive.

See also IEEE Standard 802.11-2016 at 2616, where an 80 MHz Modulation and Coding Scheme (MCS) is mandatory.

[1.a] selecting at least a first channel and a second channel, wherein the first channel and the second channel are adjacent without any other channels

On information and belief, the Southwest Count 4 Systems and Services practice selecting at least a first channel and a second channel, wherein the first channel and the second channel are adjacent without any other channels therebetween, wherein the first channel and the second channel each have a plurality of data subcarriers, wherein the data subcarriers of the first channel and the data subcarriers of the second channel are separated by a frequency gap corresponding to one or more guard bands between the first and second channels.

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
therebetween, wherein the first channel and the second channel each have a plurality of data subcarriers, wherein the data subcarriers of the first channel and the data subcarriers of the second channel are separated by a frequency gap corresponding to one or more guard bands between the first and second channels;	On information and belief, an IEEE 802.11-2016 HT STA selects a Primary Channel and a Secondary Channel as indicated via the HT Operation element. 3. Definitions 3.242 primary channel: The common channel of operation for all stations (STAs) that are members of the basic service set (BSS). 3A.61 secondary channel: A 20 MHz channel associated with a primary channel used by high-throughput (HT) stations (STAs) for the purpose of creating a 40 MHz channel. Source: IEEE Standard 802.11n-2009 at 2, 7. 3.2 Definitions specific to IEEE Std 802.11 primary 20 MHz channel: In a 40 MHz, 80 MHz, 160 MHz, or 80+80 MHz very high throughput (VHT) basic service set (BSS), the 20 MHz channel that is used to transmit 20 MHz physical layer (PHY) protocol data units (PPDUs). In a VHT BSS, the primary 20 MHz channel is also the primary channel. secondary 20 MHz channel: In a 40 MHz very high throughput (VHT) basic service set (BSS), the 20 MHz channel adjacent to the primary 20 MHz channel that together form the 40 MHz channel of the 40 MHz VHT BSS. In an 80 MHz VHT BSS, the 20 MHz channel adjacent to the primary 20 MHz channel that together form the primary 40 MHz channel of the 80 MHz VHT BSS. In a 160 MHz or 80+80 MHz VHT BSS, the 20 MHz channel adjacent to the primary 20 MHz channel that together form the primary 40 MHz channel of the 160 MHz or 80+80 MHz VHT BSS. In a VHT BSS, the secondary 20 MHz channel is also the secondary channel.

U.S. Patent No. 8,027,326 (Claim 1)

Claim(s)

Example Southwest Count 4 Systems and Services

secondary channel: A 20 MHz channel associated with a primary channel used by high-throughput (HT) stations (STAs) for the purpose of creating a 40 MHz channel or used by very high throughput (VHT) STAs for the purpose of creating the primary 40 MHz channel.

Source: IEEE Standard 802.11-2016 at 161-63.

7.3.2.57 HT Operation element

The operation of HT STAs in the BSS is controlled by the HT Operation element. The structure of this element is defined in Figure 7-95o24.

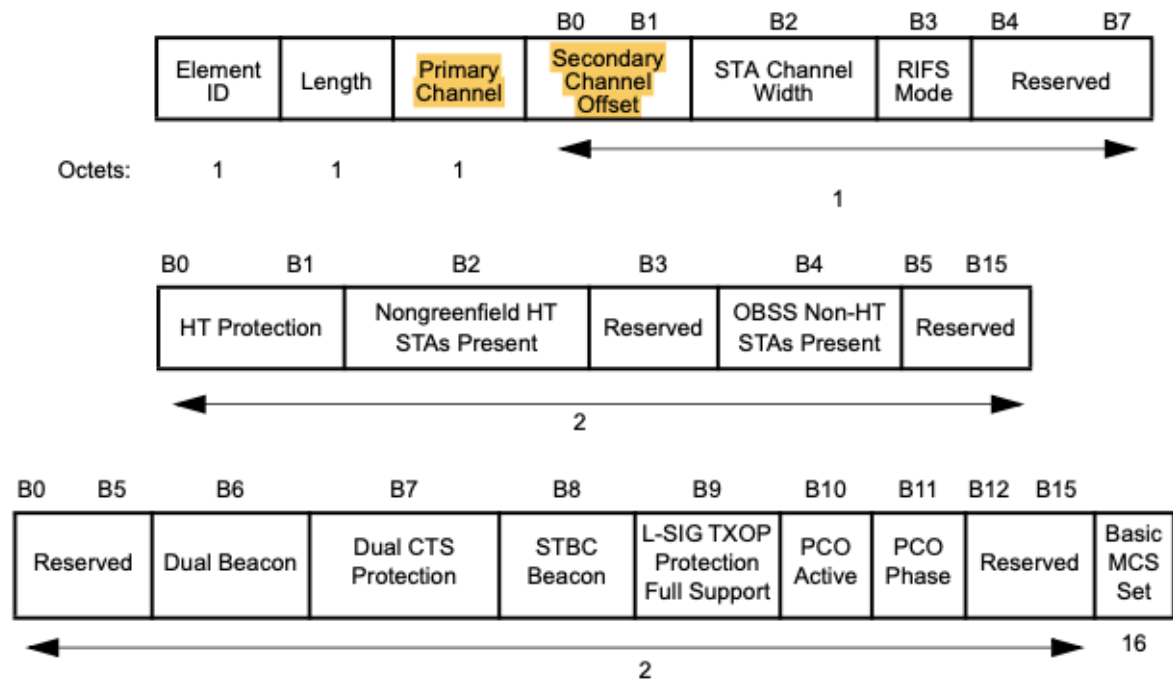


Figure 7-95o24—HT Operation element format

U.S. Patent No. 8,027,326 (Claim 1)																													
Claim(s)	Example Southwest Count 4 Systems and Services																												
	Source: IEEE Standard 802.11n-2009 at 76. 9.4.2.57 HT Operation element The operation of HT STAs in the BSS is controlled by the HT Operation element. The structure of this element is defined in Figure 9-338. <table><tr><td>Element ID</td><td>Length</td><td>Primary Channel</td><td>HT Operation Information</td><td>Basic HT-MCS Set</td></tr><tr><td>Octets:</td><td>1</td><td>1</td><td>5</td><td>16</td></tr></table> Figure 9-338—HT Operation element format Source: IEEE Standard 802.11-2016 at 950. The structure of the HT Operation Information field is shown in Figure 9-339. <table><tr><td>B0</td><td>B1</td><td>B2</td><td>B3</td><td>B4</td><td>B7</td></tr><tr><td colspan="2">Secondary Channel Offset</td><td>STA Channel Width</td><td>RIFS Mode</td><td colspan="2">Reserved</td></tr><tr><td colspan="2">Bits: 2</td><td>1</td><td>1</td><td colspan="2">4</td></tr></table> Source: IEEE Standard 802.11-2016 at 951.	Element ID	Length	Primary Channel	HT Operation Information	Basic HT-MCS Set	Octets:	1	1	5	16	B0	B1	B2	B3	B4	B7	Secondary Channel Offset		STA Channel Width	RIFS Mode	Reserved		Bits: 2		1	1	4	
Element ID	Length	Primary Channel	HT Operation Information	Basic HT-MCS Set																									
Octets:	1	1	5	16																									
B0	B1	B2	B3	B4	B7																								
Secondary Channel Offset		STA Channel Width	RIFS Mode	Reserved																									
Bits: 2		1	1	4																									

U.S. Patent No. 8,027,326 (Claim 1)

Claim(s)

Example Southwest Count 4 Systems and Services

The fields of the HT Operation element are defined in Table 7-43p. The “Reserved in IBSS?” column indicates whether each field is reserved (Y) or not reserved (N) when this element is present in a frame transmitted within an IBSS.

Table 7-43p—HT Operation element

Field	Definition	Encoding	Reserved in IBSS ?
Primary Channel	Indicates the channel number of the primary channel. See 11.14.2.	Channel number of the primary channel	N
Secondary Channel Offset	Indicates the offset of the secondary channel relative to the primary channel.	Set to 1 (SCA) if the secondary channel is above the primary channel Set to 3 (SCB) if the secondary channel is below the primary channel Set to 0 (SCN) if no secondary channel is present The value 2 is reserved	N

Source: IEEE Standard 802.11n-2009 at 77.

U.S. Patent No. 8,027,326 (Claim 1)

Claim(s)

Example Southwest Count 4 Systems and Services

Figure 9-339—HT Operation Information field

The Primary Channel field, subfields of the HT Operation Information field, and the Basic HT-MCS Set field are defined in Table 9-168. The “Reserved in IBSS?” column indicates whether each field is reserved (Y) or not reserved (N) when this element is present in a frame transmitted within an IBSS. The “Reserved in MBSS?” column indicates whether each field is reserved (Y) or not reserved (N) when this element is present in a frame transmitted within an MBSS.

Table 9-168—HT Operation element fields and subfields

Field	Definition	Encoding	Reserved in IBSS?	Reserved in MBSS?
Primary Channel	Indicates the channel number of the primary channel. See 11.16.2.	Channel number of the primary channel	N	N
Secondary Channel Offset	Indicates the offset of the secondary channel relative to the primary channel.	Set to 1 (SCA) if the secondary channel is above the primary channel Set to 3 (SCB) if the secondary channel is below the primary channel Set to 0 (SCN) if no secondary channel is present The value 2 is reserved	N	N

Source: IEEE Standard 802.11-2016 at 951.

U.S. Patent No. 8,027,326 (Claim 1)

Claim(s)

Example Southwest Count 4 Systems and Services

Table 20-5—Timing-related constants

Parameter	TXVECTOR CH_BANDWIDTH			
	NON_HT_CBW20	HT_CBW_20	HT_CBW40 or NON_HT_CBW40	
			HT format	MCS 32 and non-HT duplicate
N_{SD} : Number of complex data numbers	48	52	108	48
N_{SP} : Number of pilot values	4	4	6	4
N_{ST} : Total number of subcarriers See NOTE 1	52	56	114	104

Source: IEEE Standard 802.11n-2009 at Table 20-5.

Table 19-6—Timing-related constants

Parameter	TXVECTOR CH_BANDWIDTH			
	NON_HT_CBW20	HT_CBW_20	HT_CBW40 or NON_HT_CBW40	
			HT format	MCS 32 and non-HT duplicate
N_{SD} : Number of complex data numbers	48	52	108	48
N_{SP} : Number of pilot values	4	4	6	4

Source: IEEE Standard 802.11-2016 at Table 19-6.

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	40MHz OFDM 802.11N • 802.11n also introduced a 40 MHz channel, which combined two 20 MHz channels • The 40 MHz channel consists of 128 subcarriers: • 128 subcarriers: • 108 transmit data subcarriers • 6 as pilot carriers • 14 unused • When two 20 MHz HT channels are bonded together, some of the formerly unused subcarriers at the bottom of the higher channel and at the top end of the lower channel are able to be used to transmit data. • That is why the number of subcarriers is slightly more than two times the 56 subcarriers in a 20 MHz channel. • Each bonded channel consists of a primary and secondary 20 MHz channel. • The channels must be adjacent. A positive or negative offset indicates whether the secondary channel is the channel above or the channel below the primary channel. This is pictured in Figure 19.4. Source: https://dot11ap.wordpress.com/ht-channel-width-operation/.

U.S. Patent No. 8,027,326 (Claim 1)

Claim(s)

Example Southwest Count 4 Systems and Services

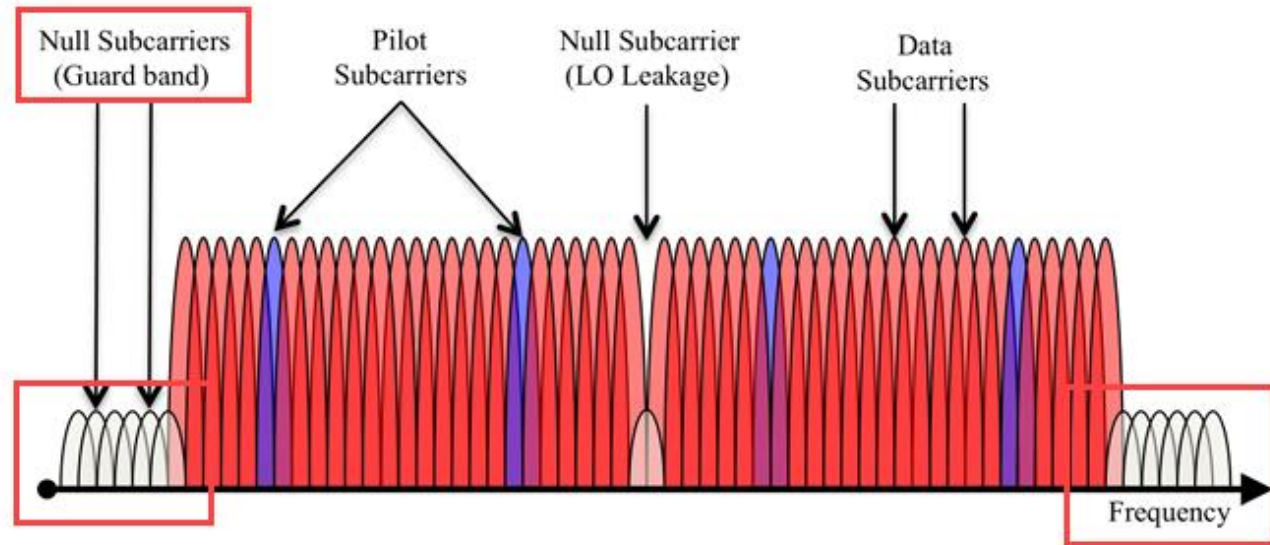


Figure 2.6. OFDM Subcarriers in the Frequency Domain.

Source: [http://download.ni.com/evaluation/rf/Introduction to WLAN Testing.pdf](http://download.ni.com/evaluation/rf/Introduction_to_WLAN_Testing.pdf).

Radio Enhancements

802.11n uses both 20-MHz and 40-MHz channels. Like the proprietary products, the 40-MHz channels in 802.11n are two adjacent 20-MHz channels, bonded together. When using the 40-MHz bonded channel, 802.11n takes advantage of the fact that each 20-MHz channel has a small amount of the channel that is reserved at the top and bottom, to reduce interference in those adjacent channels. When using 40-MHz channels, the top of the lower channel and the bottom of the upper channel don't have to be reserved to avoid interference. These small parts of the channel can now be used to carry information. By using the two 20-MHz channels more efficiently in this way, 802.11n achieves slightly more than doubling the data rate when moving from 20-MHz to 40-MHz channels.

Source: <https://vocal.com/networking/ieee-802-11n/>.

U.S. Patent No. 8,027,326 (Claim 1)

Claim(s)

Example Southwest Count 4 Systems and Services

Channel Bonding

Channel bonding is used in 802.11n to bind two 20 MHz channels, to make one 40 MHz channel. Doubling the frequency space doubles the bandwidth, and doubling the bandwidth doubles the throughput. We can make an analogy with a highway. Moving from a two lines highway to a four lines highway doubles the traffic capacity. Same result applies in network. While 802.11a and g used 20 MHz channels, 802.11n uses 40MHz channels, thanks to Channel Bonding (see the following figure).

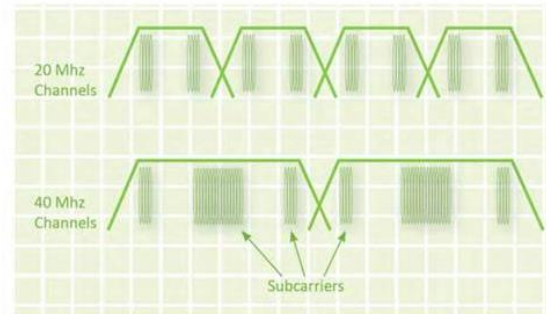


Figure 8: Channel Bonding

Source:

https://www.gta.ufri.br/ensino/eel879/trabalhos_vf_2014_2/remi/Physical%20Layer%20Improvements.html.

In fact, channel bonding more than doubles the throughput. One 20 MHz channel is composed of two 1 MHz channels, one at the beginning of the channel and one at the end, called Guard Bands. The 18 MHz left are used for data transfers. When using Channel Bonding, the two Guard Bands between two 20 MHz channels can now be used carry information.

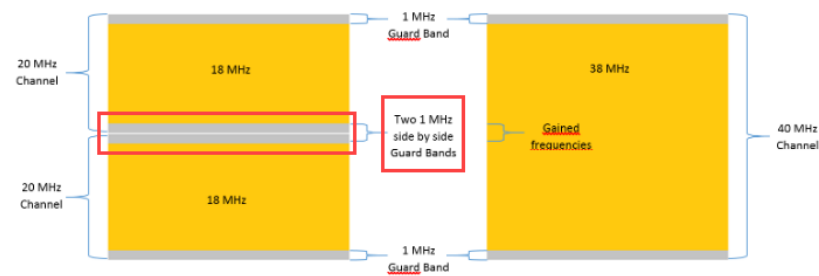


Figure 9: Gained frequencies from previous Gard Bands when using Channel Bonding

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	Source: https://www.gta.ufri.br/ensino/eel879/trabalhos_vf_2014_2/remi/Physical%20Layer%20Improvements.html. 20.3.11.10.3 Transmission in 40 MHz HT format For 40 MHz HT transmissions, the signal from transmit chain i_{TX} shall be as shown in Equation (20-59). $r_{HT-DATA}^{i_{TX}}(t) = \frac{1}{\sqrt{N_{STS} \cdot N_{HT-DATA}^{Tone}}} \sum_{n=0}^{N_{SYM}-1} w_{T_{SYM}}(t - nT_{SYM})$ $\cdot \sum_{k=-N_{SR}i_{STS}=1}^{N_{SR}} \sum_{i_{STS}}^{N_{STS}} ([Q_k]_{i_{TX}, i_{STS}}(\tilde{D}_{k, i_{STS}, n} + p_{n+z} P_{(i_{STS}, n)}^k)) Y_k \quad (20-59)$ $\cdot \exp(j2\pi k \Delta_F(t - nT_{SYM} - T_{GI} - T_{CS}^{i_{STS}}))$ Copyright © 2009 IEEE. All rights reserved. 301

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	where z is 3 in an HT-mixed format packet and 2 in an HT-greenfield format packet p_n is defined in 17.3.5.9 $\tilde{D}_{k, i_{STS}, n} = \begin{cases} 0, & k = 0, \pm 1, \pm 11, \pm 25, \pm 53 \\ \tilde{d}_{M^r(k), i_{STS}, n}, & \text{otherwise} \end{cases}$ $M^r(k) = \begin{cases} k + 58, & -58 \leq k \leq -54 \\ k + 57, & -52 \leq k \leq -26 \\ k + 56, & -24 \leq k \leq -12 \\ k + 55, & -10 \leq k \leq -2 \\ k + 52, & 2 \leq k \leq 10 \\ k + 51, & 12 \leq k \leq 24 \\ k + 50, & 26 \leq k \leq 52 \\ k + 49, & 54 \leq k \leq 58 \end{cases}$ $P_{(i_{STS}, n)}^k$ is defined in Equation (20-55) NOTE—The 90° rotation that is applied to the upper part of the 40 MHz channel is applied in the same way to the HT-STF, HT-LTF, and HT-SIG. The rotation applies to both pilots and the data in the upper part of the 40 MHz channel. Source: IEEE Standard 802.11n-2009 at 301-302.

U.S. Patent No. 8,027,326 (Claim 1)

Claim(s)

Example Southwest Count 4 Systems and Services

Grouping is a method that reduces the size of the CSI Report field by reporting a single value for each group of N_g adjacent subcarriers. With grouping, the size of the CSI Report field is $N_r \times 8 + N_s \times (3 + 2 \times N_b \times N_c \times N_r)$ bits, where the number of subcarriers sent, N_s , is a function of N_g and whether matrices for 40 MHz or 20 MHz are sent. The value of N_s and the specific carriers for which matrices are sent are shown in Table 7-25f. If the size of the CSI Report field is not an integral multiple of 8 bits, up to 7 zeros are appended to the end of the report to make its size an integral multiple of 8 bits.

Table 7-25f—Number of matrices and carrier grouping

BW	Grouping N_g	N_s	Carriers for which matrices are sent
20 MHz	1	56	All data and pilot carriers: -28, -27, ..., -2, -1, 1, 2, ..., 27, 28
	2	30	-28, -26, -24, -22, -20, -18, -16, -14, -12, -10, -8, -6, -4, -2, -1, 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 28
	4	16	-28, -24, -20, -16, -12, -8, -4, -1, 1, 5, 9, 13, 17, 21, 25, 28
40 MHz	1	114	All data and pilot carriers: -58, -57, ..., -3, -2, 2, 3, ..., 57, 58
	2	58	-58, -56, -54, -52, -50, -48, -46, -44, -42, -40, -38, -36, -34, -32, -30, -28, -26, -24, -22, -20, -18, -16, -14, -12, -10, -8, -6, -4, -2, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58
	4	30	-58, -54, -50, -46, -42, -38, -34, -30, -26, -22, -18, -14, -10, -6, -2, 2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 50, 54, 58

Source: IEEE Standard 802.11n-2009 at 50.

On information and belief, IEEE 802.11ac infringes for the same reasons as 802.11n. *See supra. See also:*

U.S. Patent No. 8,027,326 (Claim 1)

Claim(s)

Example Southwest Count 4 Systems and Services

19.3.11.11.4 Transmission in 40 MHz HT format

For 40 MHz HT transmissions, the signal from transmit chain i_{TX} shall be as shown in Equation (19-59).

$$r_{HT-DATA}^{i_{TX}}(t) = \frac{1}{\sqrt{N_{STS} \cdot N_{HT-DATA}^{T_{ore}}}} \sum_{n=0}^{N_{SYM}-1} w_{T_{SYM}}(t - nT_{SYM}) \cdot \sum_{k=-N_{SR}i_{STS}-1}^{N_{SR}-N_{STS}} ([Q_k]_{i_{TX}, i_{STS}}(\tilde{D}_{k, i_{STS}, n} + p_{n+z} P_{(i_{STS}, n)}^k) Y_k \cdot \exp(j2\pi k \Delta_F(t - nT_{SYM} - T_{GI} - T_{CS}^{i_{STS}}))) \quad (19-59)$$

where

z is 3 in an HT-mixed format packet and 2 in an HT-greenfield format packet
 p_n is defined in 17.3.5.10

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	$\tilde{D}_{k, i_{STS}, n} = \begin{cases} 0, & k = 0, \pm 1, \pm 11, \pm 25, \pm 53 \\ \tilde{d}_{M'(k), i_{STS}, n}, & \text{otherwise} \end{cases}$ $M'(k) = \begin{cases} k + 58, & -58 \leq k \leq -54 \\ k + 57, & -52 \leq k \leq -26 \\ k + 56, & -24 \leq k \leq -12 \\ k + 55, & -10 \leq k \leq -2 \\ k + 52, & 2 \leq k \leq 10 \\ k + 51, & 12 \leq k \leq 24 \\ k + 50, & 26 \leq k \leq 52 \\ k + 49, & 54 \leq k \leq 58 \end{cases}$ $P_{(i_{STS}, n)}^k$ is defined in Equation (19-55) NOTE—The 90° rotation that is applied to the upper part of the 40 MHz channel is applied in the same way to the HT-STF, HT-LTF, and HT-SIG. The rotation applies to both pilots and the data in the upper part of the 40 MHz channel. Source: IEEE Standard 802.11-2016 at 2390-2391.

U.S. Patent No. 8,027,326 (Claim 1)

Claim(s)

Example Southwest Count 4 Systems and Services

Table 9-70—Subcarriers for which a Compressed Beamforming Feedback Matrix subfield is sent back

Channel Width	N_g	N_s	Subcarriers for which Compressed Feedback Beamforming Matrix subfield is sent: $scidx(0)$, $scidx(1)$, ..., $scidx(N_s-1)$
20 MHz	1	52	-28, -27, -26, -25, -24, -23, -22, -20, -19, -18, -17, -16, -15, -14, -13, -12, -11, -10, -9, -8, -6, -5, -4, -3, -2, -1, 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 23, 24, 25, 26, 27, 28 NOTE—Pilot subcarriers (± 21 , ± 7) and DC subcarrier (0) are skipped
	2	30	-28, -26, -24, -22, -20, -18, -16, -14, -12, -10, -8, -6, -4, -2, -1, 1, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28
	4	16	-28, -24, -20, -16, -12, -8, -4, -1, 1, 4, 8, 12, 16, 20, 24, 28
40 MHz	1	108	-58, -57, -56, -55, -54, -52, -51, -50, -49, -48, -47, -46, -45, -44, -43, -42, -41, -40, -39, -38, -37, -36, -35, -34, -33, -32, -31, -30, -29, -28, -27, -26, -24, -23, -22, -21, -20, -19, -18, -17, -16, -15, -14, -13, -12, -10, -9, -8, -7, -6, -5, -4, -3, -2, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 54, 55, 56, 57, 58 NOTE—Pilot subcarriers (± 53 , ± 25 , ± 11) and DC subcarriers (0, ± 1) are skipped.
	2	58	-58, -56, -54, -52, -50, -48, -46, -44, -42, -40, -38, -36, -34, -32, -30, -28, -26, -24, -22, -20, -18, -16, -14, -12, -10, -8, -6, -4, -2, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58
	4	30	-58, -54, -50, -46, -42, -38, -34, -30, -26, -22, -18, -14, -10, -6, -2, 2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 50, 54, 58
80 MHz	1	234	-122, -121, -120, -119, -118, -117, -116, -115, -114, -113, -112, -111, -110, -109, -108, -107, -106, -105, -104, -102, -101, -100, -99, -98, -97, -96, -95, -94, -93, -92, -91, -90, -89, -88, -87, -86, -85, -84, -83, -82, -81, -80, -79, -78, -77, -76, -74, -73, -72, -71, -70, -69, -68, -67, -66, -65, -64, -63, -62, -61, -60, -59, -58, -57, -56, -55, -54, -53, -52, -51, -50, -49, -48, -47, -46, -45, -44, -43, -42, -41, -40, -38, -37, -36, -35, -34, -33, -32, -31, -30, -29, -28, -27, -26, -25, -24, -23, -22, -21, -20, -19, -18, -17, -16, -15, -14, -13, -12, -10, -9, -8, -7, -6, -5, -4, -3, -2, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122 NOTE—Pilot subcarriers (± 103 , ± 75 , ± 39 , ± 11) and DC subcarriers (0, ± 1) are skipped.

U.S. Patent No. 8,027,326 (Claim 1)					
Claim(s)	Example Southwest Count 4 Systems and Services				
	Source: IEEE Standard 802.11-2016 at 768.				
	EXPANSION_MAT_TYPE	FORMAT is VHT and EXPANSION_MAT is present.	Set to COMPRESSED_SV	Y	N
		Otherwise	See corresponding entry in Table 19-1		
	EXPANSION_MAT	FORMAT is VHT	Contains a vector in the number of selected subcarriers containing feedback matrices as defined in 21.3.11.2 based on the channel measured during the training symbols of a previous VHT NDP PPDU.	M U	N
		Otherwise	See corresponding entry in Table 19-1		
	Source: IEEE Standard 802.11-2016 at 2501.				

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	4.3.14 Very high throughput (VHT) STA The IEEE 802.11 VHT STA operates in frequency bands below 6 GHz excluding the 2.4 GHz band. A VHT STA is an HT STA that, in addition to features supported as an HT STA, supports VHT features identified in Clause 9, Clause 10, Clause 11, Clause 14, Clause 17, and Clause 21. The main PHY features in a VHT STA that are not present in an HT STA are the following: — Mandatory support for 40 MHz and 80 MHz channel widths — Mandatory support for VHT single-user (SU) PPDU — Optional support for 160 MHz and 80+80 MHz channel widths — Optional support for VHT sounding protocol to support beamforming — Optional support for VHT multi-user (MU) PPDU — Optional support for VHT-MCSs 8 and 9 Source: IEEE Standard 802.11-2016 at 197.

U.S. Patent No. 8,027,326 (Claim 1)

Claim(s)

Example Southwest Count 4 Systems and Services

Table 21-38—VHT-MCSs for mandatory 40 MHz, $N_{SS} = 1$

VHT-MCS Index	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)	
									800 ns GI	400 ns GI (See NOTE)
0	BPSK	1/2	1	108	6	108	54	1	13.5	15.0
1	QPSK	1/2	2	108	6	216	108	1	27.0	30.0
2	QPSK	3/4	2	108	6	216	162	1	40.5	45.0
3	16-QAM	1/2	4	108	6	432	216	1	54.0	60.0
4	16-QAM	3/4	4	108	6	432	324	1	81.0	90.0
5	64-QAM	2/3	6	108	6	648	432	1	108.0	120.0
6	64-QAM	3/4	6	108	6	648	486	1	121.5	135.0
7	64-QAM	5/6	6	108	6	648	540	1	135.0	150.0
8	256-QAM	3/4	8	108	6	864	648	1	162.0	180.0
9	256-QAM	5/6	8	108	6	864	720	1	180.0	200.0

NOTE—Support of 400 ns GI is optional on transmit and receive.

See also IEEE Standard 802.11-2016 at 2612, where a 40 MHz Modulation and Coding Scheme (MCS) is mandatory.

U.S. Patent No. 8,027,326 (Claim 1)

Claim(s)

Example Southwest Count 4 Systems and Services

Table 21-46—VHT-MCSs for mandatory 80 MHz, $N_{SS} = 1$

VHT-MCS Index	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBP_S}	N_{DBPS}	N_{ES}	Data rate (Mb/s)	
									800 ns GI	400 ns GI (See NOTE)
0	BPSK	1/2	1	234	8	234	117	1	29.3	32.5
1	QPSK	1/2	2	234	8	468	234	1	58.5	65.0
2	QPSK	3/4	2	234	8	468	351	1	87.8	97.5
3	16-QAM	1/2	4	234	8	936	468	1	117.0	130.0
4	16-QAM	3/4	4	234	8	936	702	1	175.5	195.0
5	64-QAM	2/3	6	234	8	1404	936	1	234.0	260.0
6	64-QAM	3/4	6	234	8	1404	1053	1	263.3	292.5
7	64-QAM	5/6	6	234	8	1404	1170	1	292.5	325.0
8	256-QAM	3/4	8	234	8	1872	1404	1	351.0	390.0
9	256-QAM	5/6	8	234	8	1872	1560	1	390.0	433.3

NOTE—Support of 400 ns GI is optional on transmit and receive.

See also IEEE Standard 802.11-2016 at 2616, where an 80 MHz Modulation and Coding Scheme (MCS) is mandatory.

[1.b] partially filling the frequency gap between the first channel and the second channel by adding one or more data subcarriers into the frequency gap such that the

On information and belief, the Southwest Count 4 Systems and Services practice partially filling the frequency gap between the first channel and the second channel by adding one or more data subcarriers into the frequency gap such that the one or more guard bands are at least partially filled with at least some of the one or more data subcarriers using full spectral synthesis capability of a fast fourier transform or an inverse fast fourier transform.

U.S. Patent No. 8,027,326 (Claim 1)

Claim(s)	Example Southwest Count 4 Systems and Services
one or more guard bands are at least partially filled with at least some of the one or more data subcarriers using full spectral synthesis capability of a fast fourier transform or an inverse fast fourier transform;	On information and belief, a 2 MHz frequency gap is present between the outer subcarriers of adjacent 20 MHz channels. In a 40 MHz bonded channel, this gap is partially filled with additional subcarriers. OFDM SUBCARRIERS USED IN 802.11A, 802.11N AND 802.11AC 52 subcarriers (48 usable) for a 20 MHz non-HT mode (legacy 802.11a/g) channel 56 subcarriers (52 usable) for a 20 MHz HT mode (802.11n) channel 114 subcarriers (108 usable) for a 40 MHz HT mode (802.11n) channel Source: https://www.cablefree.net/wirelesstechnology/802-11ac/.

U.S. Patent No. 8,027,326 (Claim 1)

Claim(s)

Example Southwest Count 4 Systems and Services

Table 7-25f—Number of matrices and carrier grouping

BW	Grouping <i>N_g</i>	<i>N_s</i>	Carriers for which matrices are sent
20 MHz	1	56	All data and pilot carriers: -28, -27,...-2, -1, 1, 2,...27, 28
	2	30	-28,-26,-24,-22,-20,-18,-16,-14,-12,-10,-8,-6,-4,-2,-1, 1,3,5,7,9,11,13,15,17,19,21,23,25,27,28
	4	16	-28,-24,-20,-16,-12,-8,-4,-1,1,5,9,13,17,21,25,28
40 MHz	1	114	All data and pilot carriers: -58, -57, ..., -3, -2, 2, 3,..., 57, 58
	2	58	-58,-56,-54,-52,-50,-48,-46,-44,-42,-40,-38,-36,-34,-32,-30, -28,-26,-24,-22,-20,-18,-16,-14,-12,-10,-8,-6,-4,-2, 2,4,6,8,10,12,14,16,18,20,22,24,26,28, 30,32,34,36,38,40,42,44,46,48,50,52,54,56,58
	4	30	-58,-54,-50,-46,-42,-38,-34,-30,-26,-22,-18,-14,-10,-6,-2, 2,6,10,14,18,22,26,30,34,38,42,46,50,54,58

Source: IEEE Standard 802.11n-2009 at 2356.

On information and belief, a 2 MHz frequency gap is present between the outer subcarriers of adjacent 20 MHz channels. In a 40 MHz bonded channel, this gap (6 sub carriers is partially filled with four additional subcarriers, corresponding to indexes -3,-2, +2 and +3. When two 20 MHz HT channels are bonded together, some of the formerly unused subcarriers at the bottom of the higher channel and at the top end of the lower channel can be used to transmit data, and the number of data subcarriers is slightly more than twice the number of subcarriers in a 40 MHz channel, as shown in table 19-6.

U.S. Patent No. 8,027,326 (Claim 1)

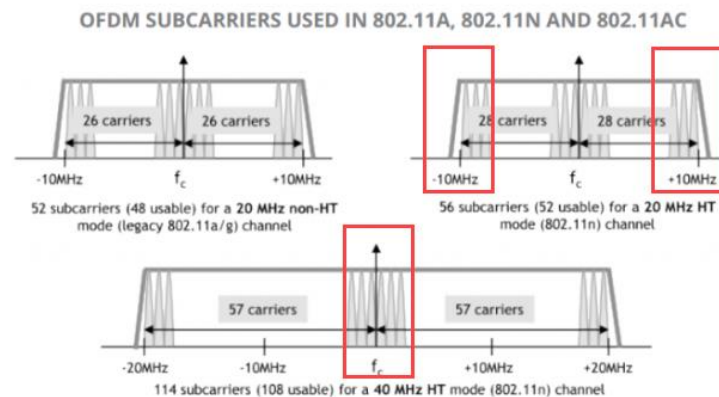
Claim(s)

Example Southwest Count 4 Systems and Services

Table 20-5—Timing-related constants

Parameter	TXVECTOR CH_BANDWIDTH			
	NON_HT_CBW20	HT_CBW_20	HT_CBW40 or NON_HT_CBW40	
			HT format	MCS 32 and non-HT duplicate
N_{SD} : Number of complex data numbers	48	52	108	48
N_{SP} : Number of pilot values	4	4	6	4
N_{ST} : Total number of subcarriers See NOTE 1	52	56	114	104

Source: IEEE Standard 802.11n-2009 at Table 20-5.



Source: <https://www.cablefree.net/wirelesstechnology/802-11ac/>.

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Claim(s)

Example Southwest Count 4 Systems and Services

Table 9-70—Subcarriers for which a Compressed Beamforming Feedback Matrix subfield is sent back

Channel Width	N_g	N_s	Subcarriers for which Compressed Feedback Beamforming Matrix subfield is sent: $scidx(0), scidx(1), \dots, scidx(N_s-1)$
20 MHz	1	52	-28, -27, -26, -25, -24, -23, -22, -20, -19, -18, -17, -16, -15, -14, -13, -12, -11, -10, -9, -8, -6, -5, -4, -3, -2, -1, 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 23, 24, 25, 26, 27, 28 NOTE—Pilot subcarriers ($\pm 21, \pm 7$) and DC subcarrier (0) are skipped
	2	30	-28, -26, -24, -22, -20, -18, -16, -14, -12, -10, -8, -6, -4, -2, -1, 1, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28
	4	16	-28, -24, -20, -16, -12, -8, -4, -1, 1, 4, 8, 12, 16, 20, 24, 28
40 MHz	1	108	-58, -57, -56, -55, -54, -52, -51, -50, -49, -48, -47, -46, -45, -44, -43, -42, -41, -40, -39, -38, -37, -36, -35, -34, -33, -32, -31, -30, -29, -28, -27, -26, -24, -23, -22, -21, -20, -19, -18, -17, -16, -15, -14, -13, -12, -10, -9, -8, -7, -6, -5, -4, -3, -2, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 54, 55, 56, 57, 58 NOTE—Pilot subcarriers ($\pm 53, \pm 25, \pm 11$) and DC subcarriers (0, ± 1) are skipped.
	2	58	-58, -56, -54, -52, -50, -48, -46, -44, -42, -40, -38, -36, -34, -32, -30, -28, -26, -24, -22, -20, -18, -16, -14, -12, -10, -8, -6, -4, -2, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58
	4	30	-58, -54, -50, -46, -42, -38, -34, -30, -26, -22, -18, -14, -10, -6, -2, 2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 50, 54, 58
80 MHz	1	234	-122, -121, -120, -119, -118, -117, -116, -115, -114, -113, -112, -111, -110, -109, -108, -107, -106, -105, -104, -102, -101, -100, -99, -98, -97, -96, -95, -94, -93, -92, -91, -90, -89, -88, -87, -86, -85, -84, -83, -82, -81, -80, -79, -78, -77, -76, -74, -73, -72, -71, -70, -69, -68, -67, -66, -65, -64, -63, -62, -61, -60, -59, -58, -57, -56, -55, -54, -53, -52, -51, -50, -49, -48, -47, -46, -45, -44, -43, -42, -41, -40, -38, -37, -36, -35, -34, -33, -32, -31, -30, -29, -28, -27, -26, -25, -24, -23, -22, -21, -20, -19, -18, -17, -16, -15, -14, -13, -12, -10, -9, -8, -7, -6, -5, -4, -3, -2, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122 NOTE—Pilot subcarriers ($\pm 103, \pm 75, \pm 39, \pm 11$) and DC subcarriers (0, ± 1) are skipped.

U.S. Patent No. 8,027,326 (Claim 1)					
Claim(s)	Example Southwest Count 4 Systems and Services				
	Source: IEEE Standard 802.11-2016 at 768.				
	CH_BANDWIDTH	FORMAT is HT_MF or HT_GF	Indicates whether the packet is transmitted using 40 MHz or 20 MHz channel width. Enumerated type: HT_CBW20 for 20 MHz and 40 MHz upper and 40 MHz lower modes HT_CBW40 for 40 MHz	Y	Y
		FORMAT is NON_HT	Enumerated type: NON_HT_CBW40 for non-HT duplicate format NON_HT_CBW20 for all other non-HT formats	Y	Y
Source: IEEE Standard 802.11n-2009 at 251.					
4. Abbreviations and acronyms					
IDFT inverse discrete Fourier transform					
Source: IEEE Standard 802.11n-2009 at 9.					

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	20.3.7 Mathematical description of signals For the description of the convention on mathematical description of signals, see 17.3.2.4. In the case of either a 20 MHz non-HT format (TXVECTOR parameter FORMAT set to NON_HT, MODULATION parameter set to one of {DSSS-OFDM, ERP-OFDM, OFDM}) transmission or a 20 MHz HT format (TXVECTOR parameter FORMAT set to HT_MF or HT_GF, CH_BANDWIDTH set to HT_CBW_20) transmission, the channel is divided into 64 subcarriers. In the 20 MHz non-HT format, the signal is transmitted on subcarriers -26 to -1 and 1 to 26, with 0 being the center (dc) carrier. In the 20 MHz HT format, the signal is transmitted on subcarriers -28 to -1 and 1 to 28. In the case of the 40 MHz HT format, a 40 MHz channel is used. The channel is divided into 128 subcarriers. The signal is transmitted on subcarriers -58 to -2 and 2 to 58. Source: IEEE Standard 802.11n-2009 at 267. 19.3.7 Mathematical description of signals For the description of the convention on mathematical description of signals, see 17.3.2.5. In the case of either a 20 MHz non-HT format (TXVECTOR parameter FORMAT equal to NON_HT, MODULATION parameter equal to one of {ERP-OFDM, OFDM}) transmission or a 20 MHz HT format (TXVECTOR parameter FORMAT equal to HT_MF or HT_GF, CH_BANDWIDTH equal to HT_CBW_20) transmission, the channel is divided into 64 subcarriers. In the 20 MHz non-HT format, the signal is transmitted on subcarriers -26 to -1 and 1 to 26, with 0 being the center (dc) carrier. In the 20 MHz HT format, the signal is transmitted on subcarriers -28 to -1 and 1 to 28. In the case of the 40 MHz HT format, a 40 MHz channel is used. The channel is divided into 128 subcarriers. The signal is transmitted on subcarriers -58 to -2 and 2 to 58. Source: IEEE Standard 802.11-2016 at 2356. On information and belief, the HT PHY uses a 128-point IDFT, usually implemented as an IFFT, to

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	create the transmitted signal across the full 40 MHz signal spectrum. This process involves a fast fourier transform (FFT). For transmitters and receivers to operate on that signal, there is digital signal processing or DSP. 20.3.3 Transmitter block diagram Figure 20-2 and Figure 20-3 show example transmitter block diagrams. In particular, Figure 20-2 shows the transmitter blocks used to generate the HT-SIG of the HT-mixed format PPDU. These transmitter blocks are also used to generate the non-HT portion of the HT-mixed format PPDU, except that the BCC encoder and interleaver are not used when generating the L-STF and L-LTFs. Figure 20-3 shows the transmitter blocks used to generate the Data field of the HT-mixed format and HT-greenfield format PPDUs. A subset of these transmitter blocks consisting of the constellation mapper and CSD blocks, as well as the blocks to the right of, and including, the spatial mapping block, are also used to generate the HT-STF, HT-GF-STF, and HT-LTFs. The HT-greenfield format SIGNAL field is generated using the transmitter blocks shown in Figure 20-2, augmented by additional CSD and spatial mapping blocks.

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Claim(s)

Example Southwest Count 4 Systems and Services

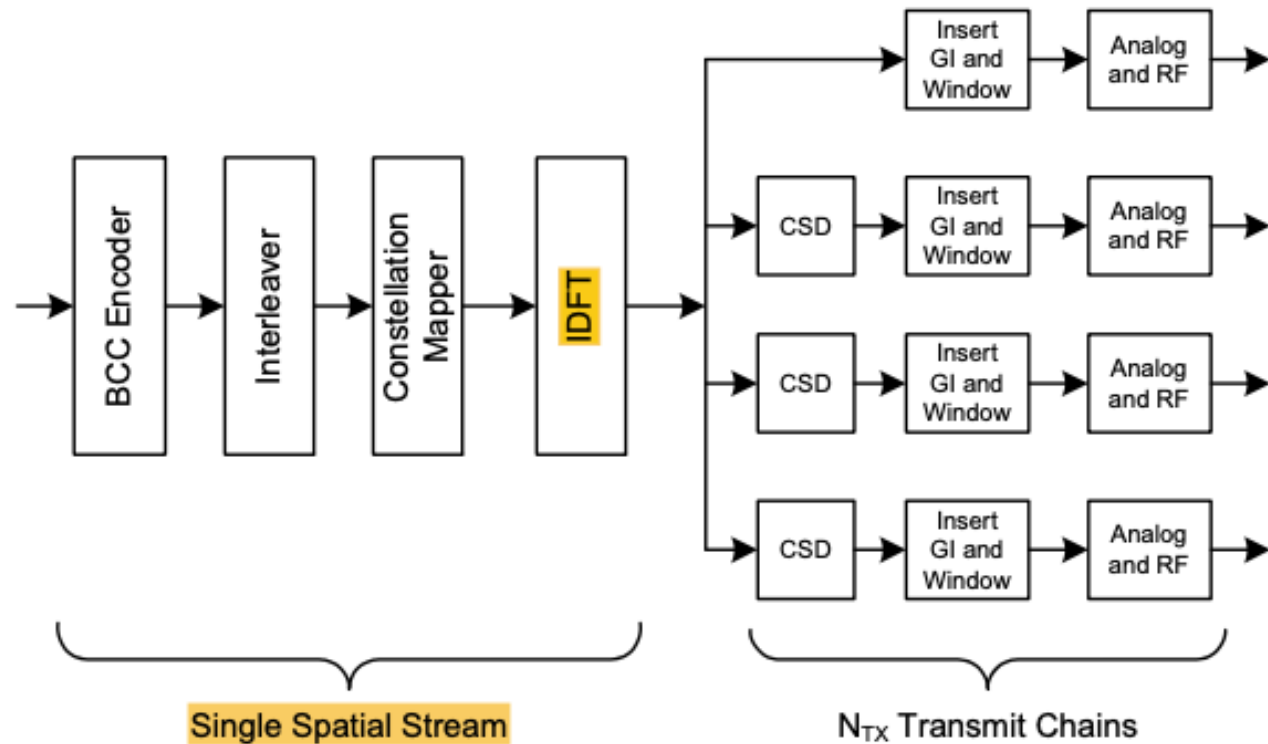


Figure 20-2—Transmitter block diagram 1

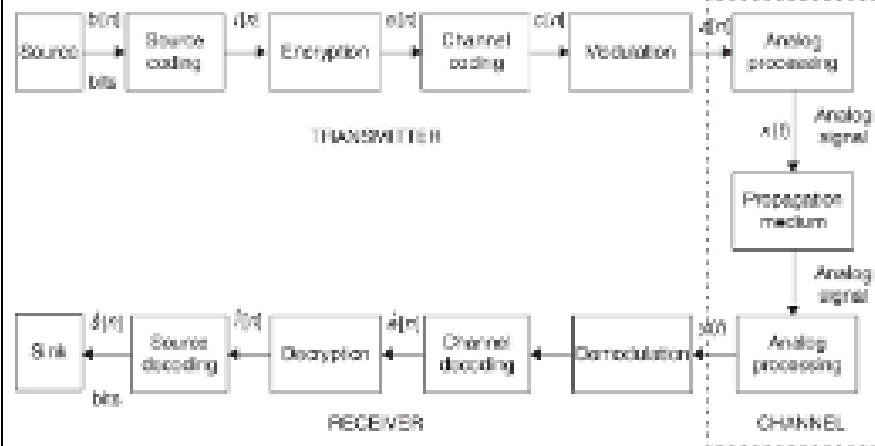
Source: IEEE Standard 802.11n-2009 at 261.

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	17.3.2.4 Mathematical conventions in the signal descriptions The transmitted signals will be described in a complex baseband signal notation. The actual transmitted signal is related to the complex baseband signal by the following relation: $r_{(RF)\phi} = Re\{r(t)\exp(j2\pi f_c t)\} \quad (17-1)$ where $Re(.)$ represents the real part of a complex variable f_c denotes the carrier center frequency The transmitted baseband signal is composed of contributions from several OFDM symbols. $r_{PACKET}(t) = r_{PREAMBLE}(t) + r_{SIGNAL}(t - t_{SIGNAL}) + r_{DATA}(t - t_{DATA}) \quad (17-2)$ The subframes of which Equation (17-2) are composed are described in 17.3.3, 17.3.4, and 17.3.5.9. The time offsets $t_{SUBFRAME}$ determine the starting time of the corresponding subframe; t_{SIGNAL} is equal to 16 μs for 20 MHz channel spacing, 32 μs for 10 MHz channel spacing, and 64 μs for 5 MHz channel spacing, and t_{DATA} is equal to 20 μs for 20 MHz channel spacing, 40 μs for 10 MHz channel spacing, and 80 μs for 5 MHz channel spacing. All the subframes of the signal are constructed as an inverse Fourier transform of a set of coefficients, C_k, with C_k defined later as data, pilots, or training symbols in 17.3.3 through 17.3.5. $r_{SUBFRAME}(t) = w_{TSUBFRAME}(t) \sum_{k=-N_{ST}/2}^{N_{ST}/2} C_k \exp(j2\pi k \Delta_f)(t - T_{GUARD}) \quad (17-3)$ Source: IEEE Standard 802.11-2007 at 598.

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Claim(s)

Example Southwest Count 4 Systems and Services



Source: R. Heath, “Introduction to Wireless Digital Communication” (2017), Figure 2.1.

See also IEEE 802.11n-2009 at Section 20.3.7 (mathematical description of signals).

On information and belief, IEEE 802.11ac infringes for the same reasons as 802.11n. See *supra*. See also:

19.3.3 Transmitter block diagram

Figure 19-2 and Figure 19-3 show example transmitter block diagrams. In particular, Figure 19-2 shows the transmitter blocks used to generate the HT-SIG of the HT-mixed format PPDU. These transmitter blocks are also used to generate the non-HT portion of the HT-mixed format PPDU, except that the BCC encoder and interleaver are not used when generating the L-STF and L-LTFs. Figure 19-3 shows the transmitter blocks used to generate the Data field of the HT-mixed format and HT-greenfield format PDUs. A subset of these transmitter blocks consisting of the constellation mapper and CSD blocks, as well as the blocks to the right of, and including, the spatial mapping block, are also used to generate the HT-STF, HT-GF-STF, and HT-LTFs. The HT-greenfield format SIGNAL field is generated using the transmitter blocks shown in Figure 19-2, augmented by additional CSD and spatial mapping blocks.

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Claim(s)

Example Southwest Count 4 Systems and Services

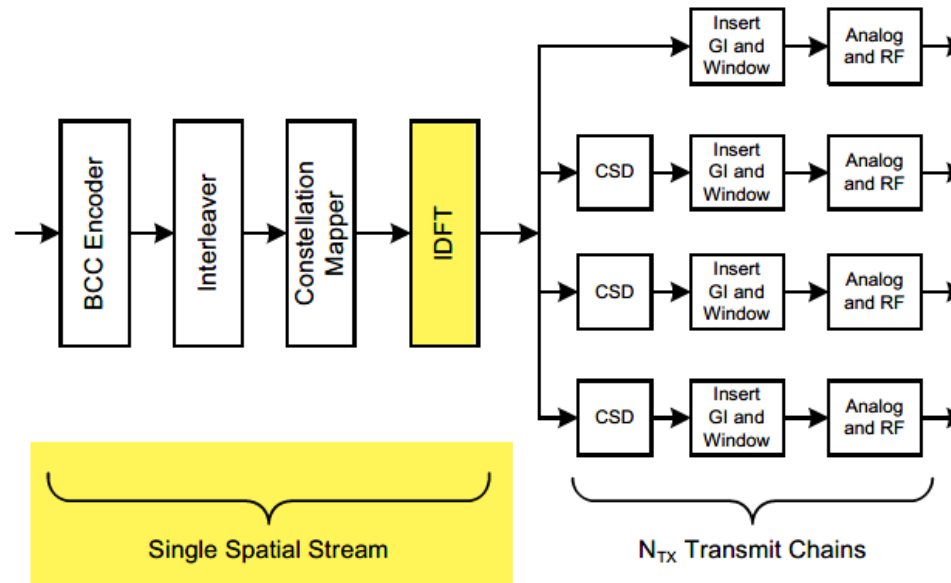


Figure 19-2—Transmitter block diagram 1

Source: IEEE Standard 802.11-2016 at 2348-350.

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	21.3.10.10 Pilot subcarriers In a 20 MHz transmission, four pilot tones shall be inserted in subcarriers $k \in \{-21, -7, 7, 21\}$. The pilot mapping P_n^k for subcarrier k for symbol n shall be as specified in Equation (21-91). $P_n^{\{-21, -7, 7, 21\}} = \{ \Psi_{1, n \bmod 4}^{(1)}, \Psi_{1, (n+1) \bmod 4}^{(1)}, \Psi_{1, (n+2) \bmod 4}^{(1)}, \Psi_{1, (n+3) \bmod 4}^{(1)} \} \quad (21-91)$ $P_n^k \notin \{-21, -7, 7, 21\} = 0$ where $\Psi_{1, m}^{(1)}$ is given by the $N_{STS} = 1$ row of Table 19-19 In a 40 MHz transmission, six pilot tones shall be inserted in subcarriers $-53, -25, -11, 11, 25$, and 53. The pilot mapping P_n^k for subcarrier k for symbol n shall be as specified in Equation (21-92). Source: IEEE Standard 802.11-2016 at 2574.

U.S. Patent No. 8,027,326 (Claim 1)

Claim(s)

Example Southwest Count 4 Systems and Services

Table 9-70—Subcarriers for which a Compressed Beamforming Feedback Matrix subfield is sent back

Channel Width	N_g	N_s	Subcarriers for which Compressed Feedback Beamforming Matrix subfield is sent: $scidx(0), scidx(1), \dots, scidx(N_s-1)$
20 MHz	1	52	-28, -27, -26, -25, -24, -23, -22, -20, -19, -18, -17, -16, -15, -14, -13, -12, -11, -10, -9, -8, -6, -5, -4, -3, -2, -1, 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 22, 23, 24, 25, 26, 27, 28 NOTE—Pilot subcarriers ($\pm 21, \pm 7$) and DC subcarrier (0) are skipped
	2	30	-28, -26, -24, -22, -20, -18, -16, -14, -12, -10, -8, -6, -4, -2, -1, 1, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28
	4	16	-28, -24, -20, -16, -12, -8, -4, -1, 1, 4, 8, 12, 16, 20, 24, 28
40 MHz	1	108	-58, -57, -56, -55, -54, -52, -51, -50, -49, -48, -47, -46, -45, -44, -43, -42, -41, -40, -39, -38, -37, -36, -35, -34, -33, -32, -31, -30, -29, -28, -27, -26, -24, -23, -22, -21, -20, -19, -18, -17, -16, -15, -14, -13, -12, -10, -9, -8, -7, -6, -5, -4, -3, -2, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 54, 55, 56, 57, 58 NOTE—Pilot subcarriers ($\pm 53, \pm 25, \pm 11$) and DC subcarriers (0, ± 1) are skipped.
	2	58	-58, -56, -54, -52, -50, -48, -46, -44, -42, -40, -38, -36, -34, -32, -30, -28, -26, -24, -22, -20, -18, -16, -14, -12, -10, -8, -6, -4, -2, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 50, 52, 54, 56, 58
	4	30	-58, -54, -50, -46, -42, -38, -34, -30, -26, -22, -18, -14, -10, -6, -2, 2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 50, 54, 58
80 MHz	1	234	-122, -121, -120, -119, -118, -117, -116, -115, -114, -113, -112, -111, -110, -109, -108, -107, -106, -105, -104, -102, -101, -100, -99, -98, -97, -96, -95, -94, -93, -92, -91, -90, -89, -88, -87, -86, -85, -84, -83, -82, -81, -80, -79, -78, -77, -76, -74, -73, -72, -71, -70, -69, -68, -67, -66, -65, -64, -63, -62, -61, -60, -59, -58, -57, -56, -55, -54, -53, -52, -51, -50, -49, -48, -47, -46, -45, -44, -43, -42, -41, -40, -38, -37, -36, -35, -34, -33, -32, -31, -30, -29, -28, -27, -26, -25, -24, -23, -22, -21, -20, -19, -18, -17, -16, -15, -14, -13, -12, -10, -9, -8, -7, -6, -5, -4, -3, -2, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122 NOTE—Pilot subcarriers ($\pm 103, \pm 75, \pm 39, \pm 11$) and DC subcarriers (0, ± 1) are skipped.

U.S. Patent No. 8,027,326 (Claim 1)					
Claim(s)	Example Southwest Count 4 Systems and Services				
	Source: IEEE Standard 802.11-2016 at 768.				
	EXPANSION_MAT_TYPE	FORMAT is VHT and EXPANSION_MAT is present.	Set to COMPRESSED_SV	Y	N
		Otherwise	See corresponding entry in Table 19-1		
	EXPANSION_MAT	FORMAT is VHT	Contains a vector in the number of selected subcarriers containing feedback matrices as defined in 21.3.11.2 based on the channel measured during the training symbols of a previous VHT NDP PPDU.	M U	N
		Otherwise	See corresponding entry in Table 19-1		
	Source: IEEE Standard 802.11-2016 at 2501.				

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	17.3.2.4 Mathematical conventions in the signal descriptions The transmitted signals will be described in a complex baseband signal notation. The actual transmitted signal is related to the complex baseband signal by the following relation: $r_{(RF)\phi} = Re\{r(t)\exp(j2\pi f_c t)\} \quad (17-1)$ where $Re(\cdot)$ represents the real part of a complex variable f_c denotes the carrier center frequency The transmitted baseband signal is composed of contributions from several OFDM symbols. $r_{PACKET}(t) = r_{PREAMBLE}(t) + r_{SIGNAL}(t - t_{SIGNAL}) + r_{DATA}(t - t_{DATA}) \quad (17-2)$ The subframes of which Equation (17-2) are composed are described in 17.3.3, 17.3.4, and 17.3.5.9. The time offsets $t_{SUBFRAME}$ determine the starting time of the corresponding subframe; t_{SIGNAL} is equal to 16 μs for 20 MHz channel spacing, 32 μs for 10 MHz channel spacing, and 64 μs for 5 MHz channel spacing, and t_{DATA} is equal to 20 μs for 20 MHz channel spacing, 40 μs for 10 MHz channel spacing, and 80 μs for 5 MHz channel spacing. All the subframes of the signal are constructed as an inverse Fourier transform of a set of coefficients, C_k, with C_k defined later as data, pilots, or training symbols in 17.3.3 through 17.3.5. $r_{SUBFRAME}(t) = w_{TSUBFRAME}(t) \sum_{k=-N_{ST}/2}^{N_{ST}/2} C_k \exp(j2\pi k \Delta_f)(t - T_{GUARD}) \quad (17-3)$ Source: IEEE Standard 802.11-2007 at 598.
[1.c] combining the first channel and the second channel using channel bonding with orthogonal frequency division multiplexing (OFDM); and	On information and belief, the Southwest Count 4 Systems and Services practice combining the first channel and the second channel using channel bonding with orthogonal frequency division multiplexing (OFDM). On information and belief, in 40 MHz capable HT STA, both primary (“first”) and secondary (“second”) 20 MHz channels are combined by using channel bonding to give a wideband channel.

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	40 MHz OFDM 802.11N • 802.11n also introduced a 40 MHz channel, which combined two 20 MHz channels • The 40 MHz channel consists of 128 subcarriers: • 128 subcarriers: • 108 transmit data subcarriers • 6 as pilot carriers • 14 unused • When two 20 MHz HT channels are bonded together, some of the formerly unused subcarriers at the bottom of the higher channel and at the top end of the lower channel are able to be used to transmit data. • That is why the number of subcarriers is slightly more than two times the 56 subcarriers in a 20 MHz channel. • Each bonded channel consists of a primary and secondary 20 MHz channel. • The channels must be adjacent. A positive or negative offset indicates whether the secondary channel is the channel above or the channel below the primary channel. This is pictured in Figure 19.4. Source: https://dot11ap.wordpress.com/ht-channel-width-operation/. 20. High Throughput (HT) PHY specification

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	20.3.11.10 OFDM modulation 20.3.11.10.3 Transmission in 40 MHz HT format For 40 MHz HT transmissions, the signal from transmit chain i_{TX} shall be as shown in Equation (20-59). $r_{HT-DATA}^{i_{TX}}(t) = \frac{1}{\sqrt{N_{STS} \cdot N_{HT-DATA}^{Tone}}} \sum_{n=0}^{N_{SYM}-1} w_{T_{SYM}}(t - nT_{SYM})$ $\cdot \sum_{k=-N_{SR}i_{STS}=1}^{N_{SR}} \sum_{i_{STS}}^{N_{STS}} ([Q_k]_{i_{TX}, i_{STS}} (\tilde{D}_{k, i_{STS}, n} + P_{n+z} P_{(i_{STS}, n)}^k) Y_k$ $\cdot \exp(j2\pi k \Delta_F(t - nT_{SYM} - T_{GI} - T_{CS}^{i_{STS}})))$ Copyright © 2009 IEEE. All rights reserved. 301

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	where z is 3 in an HT-mixed format packet and 2 in an HT-greenfield format packet p_n is defined in 17.3.5.9 $\tilde{D}_{k, i_{STS}, n} = \begin{cases} 0, & k = 0, \pm 1, \pm 11, \pm 25, \pm 53 \\ \tilde{d}_{M^r(k), i_{STS}, n}, & \text{otherwise} \end{cases}$ $M^r(k) = \begin{cases} k + 58, & -58 \leq k \leq -54 \\ k + 57, & -52 \leq k \leq -26 \\ k + 56, & -24 \leq k \leq -12 \\ k + 55, & -10 \leq k \leq -2 \\ k + 52, & 2 \leq k \leq 10 \\ k + 51, & 12 \leq k \leq 24 \\ k + 50, & 26 \leq k \leq 52 \\ k + 49, & 54 \leq k \leq 58 \end{cases}$ $P_{(i_{STS}, n)}^k$ is defined in Equation (20-55) NOTE—The 90° rotation that is applied to the upper part of the 40 MHz channel is applied in the same way to the HT-STF, HT-LTF, and HT-SIG. The rotation applies to both pilots and the data in the upper part of the 40 MHz channel. Source: IEEE Standard 802.11n-2009 at 247, 298, 301-302. Improved OFDM and Channel Bonding

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	802.11n uses a more efficient OFDM modulation and can use 40 MHz channels. This more than doubles the data rate for 802.11n when compared to 20 MHz channels. When operating within a traditional 20 MHz channel, OFDM further slices the channel into 52 subcarriers (48 of which are used for carrying data). However, when 802.11n applies OFDM on a 40 MHz channel, the number of data-carrying subcarriers do not simply double to 96 sub-carriers. Instead, they actually more than double to 114 subcarriers, including pilots (which do not carry data). This allows 802.11n to deliver a 65 Mbps data rate (instead of 54 Mbps) per 20 MHz channel for a total of 135 Mbps on a 40 MHz channel when transmitting a single spatial data stream. When transmitting using 2 spatial streams on a 40 MHz channel, this data rate again doubles to 135 Mbps x 2 — 270 Mbps. Source: https://www.winncom.com/images/stories/Motorola_802.11nDEM_WP_v4_0209.pdf. HT-OFDM 802.11a and g used Orthogonal Frequency Division Multiplexing (OFDM) to transmit information. 802.11n continues to use OFDM but in a slightly different way. This new version is called HT-OFDM for High Throughput OFDM. How does OFDM works? The OFDM divides a channel into several subcarriers to carry information. For example, 802.11a and g use an OFDM that divides the 20MHz channels into 52 subcarriers. 48 of those are used for data transmission and 4 others are used for forward error correction. This configuration offers a data rates of 54 Mbps at best. When 802.11n uses 20MHz channels, HT-OFDM now offers 56 subcarriers. There are still 4 that are used for forward error correction and now 52 that are used for data transmission. This marginally increases the data rates to a maximum of 65 Mbps. This is when we use a single-transmitter radio. For two transmitters, the maximum data rates is 130 Mbps. Three transmitters provide a maximum data rates of 195 Mbps. The maximum four transmitters can deliver 260 Mbps. When a 40MHz channel is used, we get 108 subcarriers to transmit data information and 6 subcarriers for forward error correction. This way the channel is divided into 114 subcarriers. This provides a maximum data rates of 135 Mbps, 270 Mbps, 405 Mbps, and 540 Mbps for one through four transmitters, respectively. Source:

U.S. Patent No. 8,027,326 (Claim 1)

Claim(s)

Example Southwest Count 4 Systems and Services

https://www.gta.ufrj.br/ensino/eel879/trabalhos_vf_2014_2/remi/Physical%20Layer%20Improvements.html.

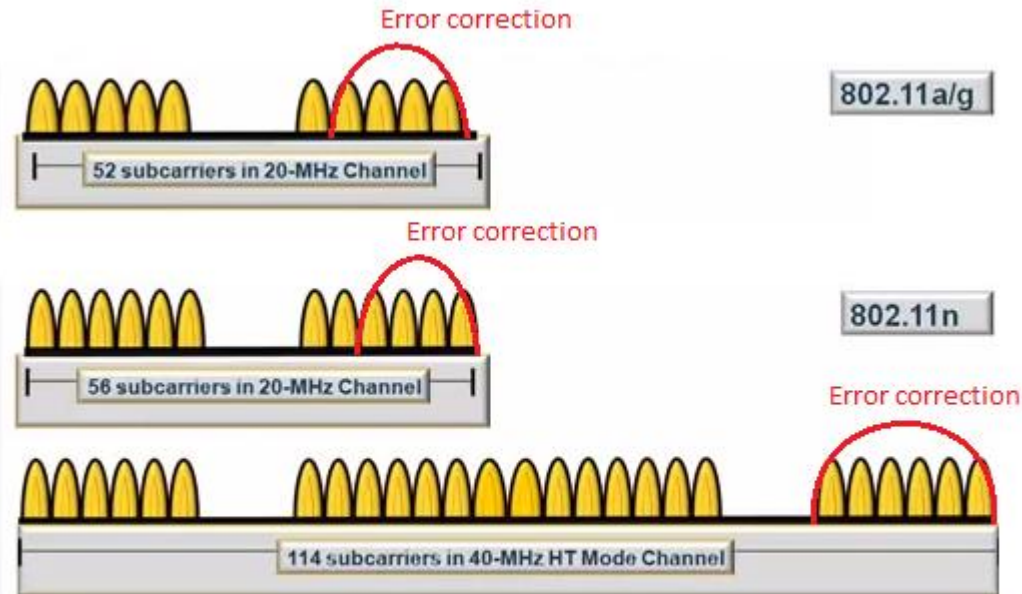


Figure 10: Number of subcarriers offered by OFDM

Source:

https://www.gta.ufrj.br/ensino/eel879/trabalhos_vf_2014_2/remi/Physical%20Layer%20Improvements.html.

On information and belief, IEEE 802.11ac infringes for the same reasons as 802.11n. *See supra*. *See also*:

19. High-throughput (HT) PHY specification

U.S. Patent No. 8,027,326 (Claim 1)

Claim(s)	Example Southwest Count 4 Systems and Services
	19.3.11.11 OFDM modulation 19.3.11.11.4 Transmission in 40 MHz HT format For 40 MHz HT transmissions, the signal from transmit chain i_{TX} shall be as shown in Equation (19-59). $r_{HT-DATA}^{i_{TX}}(t) = \frac{1}{\sqrt{N_{STS} \cdot N_{HT-DATA}^{T_{ore}}}} \sum_{n=0}^{N_{SYM}-1} w_{T_{SYM}}(t - nT_{SYM})$ $\cdot \sum_{k=-N_{SR}i_{STS}-1}^{N_{SR}} \sum_{i_{STS}}^{N_{STS}} ([Q_k]_{i_{TX}, i_{STS}} (\tilde{D}_{k, i_{STS}n + p_n + z} P_{(i_{STS}, n)}^k) Y_k) \quad (19-59)$ $\cdot \exp(j2\pi k \Delta_f (t - nT_{SYM} - T_{GI} - T_{CS}^{i_{STS}})))$ where z is 3 in an HT-mixed format packet and 2 in an HT-greenfield format packet p_n is defined in 17.3.5.10

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	$\tilde{D}_{k, i_{STS}, n} = \begin{cases} 0, & k = 0, \pm 1, \pm 11, \pm 25, \pm 53 \\ \tilde{d}_{M'(k), i_{STS}, n}, & \text{otherwise} \end{cases}$ $M'(k) = \begin{cases} k + 58, & -58 \leq k \leq -54 \\ k + 57, & -52 \leq k \leq -26 \\ k + 56, & -24 \leq k \leq -12 \\ k + 55, & -10 \leq k \leq -2 \\ k + 52, & 2 \leq k \leq 10 \\ k + 51, & 12 \leq k \leq 24 \\ k + 50, & 26 \leq k \leq 52 \\ k + 49, & 54 \leq k \leq 58 \end{cases}$ $P_{(i_{STS}, n)}^k$ is defined in Equation (19-55) NOTE—The 90° rotation that is applied to the upper part of the 40 MHz channel is applied in the same way to the HT-STF, HT-LTF, and HT-SIG. The rotation applies to both pilots and the data in the upper part of the 40 MHz channel. Source: IEEE Standard 802.11-2016 at 2334, 2387, 2390-2391.
[1.d] transmitting data subcarriers occupying the first channel, the second channel, and the frequency gap in parallel to a receiver.	On information and belief, the Southwest Count 4 Systems and Services practice transmitting data subcarriers occupying the first channel, the second channel, and the frequency gap in parallel to a receiver. On information and belief, subcarriers occupying both channels and the partially-filled frequency gap are transmitted in parallel. 20.3.4 Overview of the PPDU encoding process

U.S. Patent No. 8,027,326 (Claim 1)

Claim(s)	Example Southwest Count 4 Systems and Services
	o) Determine whether 20 MHz or 40 MHz operation is to be used from the CH_BANDWIDTH parameter of the TXVECTOR. Specifically, when CH_BANDWIDTH is HT_CBW20 or NON_HT_CBW20, 20 MHz operation is to be used. When CH_BANDWIDTH is HT_CBW40 or NON_HT_CBW40, 40 MHz operation is to be used. For 20 MHz operation (with the exception of non-HT formats), insert four subcarriers as pilots into positions -21, -7, 7, and 21. The total number of the subcarriers, N_{ST}, is 56. For 40 MHz operation (with the exception of MCS 32 and non-HT duplicate format), insert six subcarriers as pilots into positions -53, -25, -11, 11, 25, and 53, resulting in a total of $N_{ST} = 114$ subcarriers. See 20.3.11.10.4 for pilot locations when using MCS 32 and 20.3.11.11 for pilot locations when using non-HT duplicate format. The pilots are modulated using a pseudo-random cover sequence. Refer to 20.3.11.9 for details. For 40 MHz operation, apply a +90 degree phase shift to the complex value in each OFDM subcarrier with an index greater than 0, as described in 20.3.11.10.3, 20.3.11.10.4, and 20.3.11.11. p) Map each of the complex numbers in each of the N_{ST} subcarriers in each of the OFDM symbols in each of the N_{STS} space-time streams to the N_{TX} transmit chain inputs. For direct-mapped operation, $N_{TX} = N_{STS}$, and there is a one-to-one correspondence between space-time streams and transmit chains. In this case, the OFDM symbols associated with each space-time stream are also associated with the corresponding transmit chain. Otherwise, a spatial mapping matrix associated with each OFDM subcarrier, as indicated by the EXPANSION_MAT parameter of the TXVECTOR, is used to perform a linear transformation on the vector of N_{STS} complex numbers associated with each subcarrier in each OFDM symbol. This spatial mapping matrix maps the vector of N_{STS} complex numbers in each subcarrier into a vector of N_{TX} complex numbers in each subcarrier. The sequence of N_{ST} complex numbers associated with each transmit chain (where each of the N_{ST} complex numbers is taken from the same position in the N_{TX} vector of complex numbers across the N_{ST} subcarriers associated with an OFDM symbol) constitutes an OFDM symbol associated with the corresponding transmit chain. For details, see 20.3.11.10. Spatial mapping matrices may include cyclic shifts, as described in 20.3.11.10.1.

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	t) Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit. Refer to 20.3.7 for details. The transmit chains are connected to antenna elements according to ANTENNA_SET of the TXVECTOR if ASEL is applied. Source: IEEE Standard 802.11n-2009 at 262-264. On information and belief, IEEE 802.11ac infringes for the same reasons as 802.11n. <i>See supra. See also:</i> 19.3.4 Overview of the PPDU encoding process

U.S. Patent No. 8,027,326 (Claim 1)

Claim(s)	Example Southwest Count 4 Systems and Services
	o) Determine whether 20 MHz or 40 MHz operation is to be used from the CH_BANDWIDTH parameter of the TXVECTOR. Specifically, when CH_BANDWIDTH is HT_CBW20 or NON_HT_CBW20, 20 MHz operation is to be used. When CH_BANDWIDTH is HT_CBW40 or NON_HT_CBW40, 40 MHz operation is to be used. For 20 MHz operation (with the exception of non-HT formats), insert four subcarriers as pilots into positions -21, -7, 7, and 21. The total number of the subcarriers, N_{ST}, is 56. For 40 MHz operation (with the exception of MCS 32 and non-HT duplicate format), insert six subcarriers as pilots into positions -53, -25, -11, 11, 25, and 53, resulting in a total of $N_{ST} = 114$ subcarriers. See 19.3.11.11.5 for pilot locations when using MCS 32 and 19.3.11.12 for pilot locations when using non-HT duplicate format. The pilots are modulated using a pseudorandom cover sequence. Refer to 19.3.11.10 for details. For 40 MHz operation, apply a $+90^\circ$ phase shift to the complex value in each OFDM subcarrier with an index greater than 0, as described in 19.3.11.11.4, 19.3.11.11.5, and 19.3.11.12. p) Map each of the complex numbers in each of the N_{ST} subcarriers in each of the OFDM symbols in each of the N_{STS} space-time streams to the N_{TX} transmit chain inputs. For direct-mapped operation, $N_{TX} = N_{STS}$, and there is a one-to-one correspondence between space-time streams and transmit chains. In this case, the OFDM symbols associated with each space-time stream are also associated with the corresponding transmit chain. Otherwise, a spatial mapping matrix associated with each OFDM subcarrier, as indicated by the EXPANSION_MAT parameter of the TXVECTOR, is used to perform a linear transformation on the vector of N_{STS} complex numbers associated with each subcarrier in each OFDM symbol. This spatial mapping matrix maps the vector of N_{STS} complex numbers in each subcarrier into a vector of N_{TX} complex numbers in each subcarrier. The sequence of N_{ST} complex numbers associated with each transmit chain (where each of the N_{ST} complex numbers is taken from the same position in the N_{TX} vector of complex numbers across the N_{ST} subcarriers associated with an OFDM symbol) constitutes an OFDM symbol associated with the corresponding transmit chain. For details, see 19.3.11.11. Spatial mapping matrices may include cyclic shifts, as described in 19.3.11.11.2.

U.S. Patent No. 8,027,326 (Claim 1)	
Claim(s)	Example Southwest Count 4 Systems and Services
	t) Upconvert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit. Refer to 19.3.7 for details. The transmit chains are connected to antenna elements according to ANTENNA_SET of the TXVECTOR if ASEL is applied. Source: IEEE Standard 802.11-2016 at 2349-2353.

U.S. Patent No. 8,027,326 (Claim 4)	
Claim 4	Example Southwest Count 4 Systems and Services
[4] The method of claim 1, wherein transmitting the first channel and the second channel comprises transmitting to multiple radios.	On information and belief, the Southwest Count 4 Systems and Services practice the method of claim 1. See claim 1. On information and belief, the Southwest Count 4 Systems and Services further practice the transmitting the first channel and the second channel includes transmitting to multiple radios. On information and belief, subcarriers occupying both channels and the partially-filled frequency gap are transmitted in parallel, and can be transmitted to multiple radios. 20.3.4 Overview of the PPDU encoding process

U.S. Patent No. 8,027,326 (Claim 4)

Claim 4	Example Southwest Count 4 Systems and Services
	o) Determine whether 20 MHz or 40 MHz operation is to be used from the CH_BANDWIDTH parameter of the TXVECTOR. Specifically, when CH_BANDWIDTH is HT_CBW20 or NON_HT_CBW20, 20 MHz operation is to be used. When CH_BANDWIDTH is HT_CBW40 or NON_HT_CBW40, 40 MHz operation is to be used. For 20 MHz operation (with the exception of non-HT formats), insert four subcarriers as pilots into positions -21, -7, 7, and 21. The total number of the subcarriers, N_{ST}, is 56. For 40 MHz operation (with the exception of MCS 32 and non-HT duplicate format), insert six subcarriers as pilots into positions -53, -25, -11, 11, 25, and 53, resulting in a total of $N_{ST} = 114$ subcarriers. See 20.3.11.10.4 for pilot locations when using MCS 32 and 20.3.11.11 for pilot locations when using non-HT duplicate format. The pilots are modulated using a pseudo-random cover sequence. Refer to 20.3.11.9 for details. For 40 MHz operation, apply a +90 degree phase shift to the complex value in each OFDM subcarrier with an index greater than 0, as described in 20.3.11.10.3, 20.3.11.10.4, and 20.3.11.11. p) Map each of the complex numbers in each of the N_{ST} subcarriers in each of the OFDM symbols in each of the N_{STS} space-time streams to the N_{TX} transmit chain inputs. For direct-mapped operation, $N_{TX} = N_{STS}$, and there is a one-to-one correspondence between space-time streams and transmit chains. In this case, the OFDM symbols associated with each space-time stream are also associated with the corresponding transmit chain. Otherwise, a spatial mapping matrix associated with each OFDM subcarrier, as indicated by the EXPANSION_MAT parameter of the TXVECTOR, is used to perform a linear transformation on the vector of N_{STS} complex numbers associated with each subcarrier in each OFDM symbol. This spatial mapping matrix maps the vector of N_{STS} complex numbers in each subcarrier into a vector of N_{TX} complex numbers in each subcarrier. The sequence of N_{ST} complex numbers associated with each transmit chain (where each of the N_{ST} complex numbers is taken from the same position in the N_{TX} vector of complex numbers across the N_{ST} subcarriers associated with an OFDM symbol) constitutes an OFDM symbol associated with the corresponding transmit chain. For details, see 20.3.11.10. Spatial mapping matrices may include cyclic shifts, as described in 20.3.11.10.1.

U.S. Patent No. 8,027,326 (Claim 4)	
Claim 4	Example Southwest Count 4 Systems and Services
	t) Up-convert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit. Refer to 20.3.7 for details. The transmit chains are connected to antenna elements according to ANTENNA_SET of the TXVECTOR if ASEL is applied. Source: IEEE Standard 802.11n-2009 at 262-264. On information and belief, IEEE 802.11ac infringes for the same reasons as 802.11n. <i>See supra. See also:</i> 19.3.4 Overview of the PPDU encoding process

U.S. Patent No. 8,027,326 (Claim 4)

Claim 4	Example Southwest Count 4 Systems and Services
	o) Determine whether 20 MHz or 40 MHz operation is to be used from the CH_BANDWIDTH parameter of the TXVECTOR. Specifically, when CH_BANDWIDTH is HT_CBW20 or NON_HT_CBW20, 20 MHz operation is to be used. When CH_BANDWIDTH is HT_CBW40 or NON_HT_CBW40, 40 MHz operation is to be used. For 20 MHz operation (with the exception of non-HT formats), insert four subcarriers as pilots into positions -21, -7, 7, and 21. The total number of the subcarriers, N_{ST}, is 56. For 40 MHz operation (with the exception of MCS 32 and non-HT duplicate format), insert six subcarriers as pilots into positions -53, -25, -11, 11, 25, and 53, resulting in a total of $N_{ST} = 114$ subcarriers. See 19.3.11.11.5 for pilot locations when using MCS 32 and 19.3.11.12 for pilot locations when using non-HT duplicate format. The pilots are modulated using a pseudorandom cover sequence. Refer to 19.3.11.10 for details. For 40 MHz operation, apply a $+90^\circ$ phase shift to the complex value in each OFDM subcarrier with an index greater than 0, as described in 19.3.11.11.4, 19.3.11.11.5, and 19.3.11.12. p) Map each of the complex numbers in each of the N_{ST} subcarriers in each of the OFDM symbols in each of the N_{STS} space-time streams to the N_{TX} transmit chain inputs. For direct-mapped operation, $N_{TX} = N_{STS}$, and there is a one-to-one correspondence between space-time streams and transmit chains. In this case, the OFDM symbols associated with each space-time stream are also associated with the corresponding transmit chain. Otherwise, a spatial mapping matrix associated with each OFDM subcarrier, as indicated by the EXPANSION_MAT parameter of the TXVECTOR, is used to perform a linear transformation on the vector of N_{STS} complex numbers associated with each subcarrier in each OFDM symbol. This spatial mapping matrix maps the vector of N_{STS} complex numbers in each subcarrier into a vector of N_{TX} complex numbers in each subcarrier. The sequence of N_{ST} complex numbers associated with each transmit chain (where each of the N_{ST} complex numbers is taken from the same position in the N_{TX} vector of complex numbers across the N_{ST} subcarriers associated with an OFDM symbol) constitutes an OFDM symbol associated with the corresponding transmit chain. For details, see 19.3.11.11. Spatial mapping matrices may include cyclic shifts, as described in 19.3.11.11.2.

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Claim 4	Example Southwest Count 4 Systems and Services
	t) Upconvert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit. Refer to 19.3.7 for details. The transmit chains are connected to antenna elements according to ANTENNA_SET of the TXVECTOR if ASEI is applied. Source: IEEE Standard 802.11-2016 at 2349-2353. 802.11n In January, 2004 the IEEE 802.11 task group initiated work. The standard was finally ratified in September 2009. The goal of 802.11n is to significantly increase the data throughput rate. While there are a number of technical changes, one important change is the addition of multiple-input multiple-output (MIMO) and spatial multiplexing. Multiple antennas are used in MIMO, which use multiple radios and therefore utilizes more electrical power. Source: https://www.air802.com/ieee-802.11-standards-facts-amp-channels.html.

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Claim 18	Example Southwest Count 4 Systems and Services
[18.pre]. A non-transitory computer-readable medium having instructions stored thereon, the instructions comprising:	To the extent this preamble is limiting, on information and belief, the Southwest Count 4 Systems and Services include a non-transitory computer-readable medium having instructions stored thereon. On information and belief, Southwest provides in flight Wi-Fi connectivity through provider equipment provided by at least Viasat and Anuvu that includes memory and stores software for executing instructions relating to the limitations of this claim. This equipment is compliant with Wi-Fi 802.11n and 802.11ac protocols. For example, the Viasat equipment and Anuvu equipment is compliant with the Wi-Fi 802.11n and 802.11ac protocols.

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Claim 18

Example Southwest Count 4 Systems and Services

We're excited to announce that as of yesterday, March 9, 2023, our first aircraft equipped with hardware from our new WiFi vendor, Viasat, has entered service. Viasat is an industry leader, and we're excited about the increased connectivity and reliability that Viasat will provide. As we prepare for additional Viasat-equipped aircraft deliveries, we're also making significant progress updating our existing fleet with new Anuvu hardware (our original WiFi vendor). We have now upgraded more than 400 aircraft and are well on our way to upgrading the entire fleet by the third quarter of this year.

Between our upgraded Anuvu hardware and integration of Viasat, we're bringing a faster, more reliable WiFi experience. In addition to improved WiFi quality, Viasat offers Customers the ability to trade paid internet connectivity between personal devices (known as "device swapping"). For example, if a Customer has paid for Internet using their laptop, they can use the "swap device" function in the Inflight Entertainment Portal to switch connectivity to their phone.

	Anuvu Legacy	Anuvu Upgraded	Viasat
Improved Speeds and Reliability	✗	✓	✓
Streaming (when authenticated for Internet)	✗	✓	✓
Device Swap	✗	✗	✓
Free Entertainment, Texting, and Flight Tracker	✓	✓	✓

Source: <https://www.swamedia.com/southwest-stories/wifi-modernization-first-viasat-aircraft-enters-service-MC5XTXWTTLWNESJDQR4LZQBIDI2I>.

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Claim 18

Example Southwest Count 4 Systems and Services

Viasat Select Router

Redefining the in-flight connectivity experience

The Viasat Select Router, coupled with Viasat's latest generation satellite terminal, delivers a fully managed internet connectivity network inside the cabin that promises to deliver maximum speed and capabilities from Viasat's high-capacity satellite network.

Source: https://www.viasat.com/content/dam/us-site/aviation/documents/Viasat_Select_Router-datasheet.pdf.

SPECIFICATIONS

Size	1.75 in. H x 7.8 in. W x 5.5 in. D	Storage	1 TB (OS and applications)
Weight	3.9 lbs	Ethernet Ports	› 5 x 10/100/1000 bps Ethernet Ports (Switched) › 1 x 10/100/1000 bps Ethernet Ports (Direct) › 1 x 10/100/1000 bps Ethernet Ports (Front Panel)
Voltage	28VDC with 200ms Hold-up	ARINC 429	2x Rx Channels / 1x Tx Channel
Power	20W(typical); 30W (max)	Cellular Modem	Integrated Global coverage 4G/LTE Advanced modem; 2x mini SIMs; 2x RF QMA connections
Environment	Qualified to DO-160G	Wi-Fi	802.11 ac/abgn; 3x RF QMA connections
Processor	Intel E3845 4 Core processor, 1.5GHz		

Source: https://www.viasat.com/content/dam/us-site/aviation/documents/Viasat_Select_Router-datasheet.pdf.

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Claim 18	Example Southwest Count 4 Systems and Services
	Satellite-based Connectivity and Entertainment experience • High-speed internet and content streaming • Entertainment delivered as fully licensed and industry compliant • Consistent connected service with optimized network coverage • Line-fit and retro-fit installation options • Tiered payment configuration • No-touch software and content updates • Ancillary revenue models • Flying onboard over 1,000+ aircraft Direct to passenger's own device connectivity and entertainment inflight experience

U.S. Patent No. 8,027,326 (Claim 18)

Claim 18

Example Southwest Count 4 Systems and Services

Product features overview

Specifications

Airconnect Antenna (GSAA)

- Performance and accuracy
- Higher efficiency
- Reduced weight, component count
- Future proof – LEO compatible

Intelligent Server/Router (SMU)

- Dual Core i7, 32 GB RAM
- Built-in dual 4G LTE modem
- Up to 12TB for media storage, containers for tech & flight ops

Cabin Wireless LAN (CWL)

- 802.11a/b/g/n/ac standards
- Simultaneous 5 GHz/2.4 GHz radios for streaming and intense apps
- Leverages modern smartphone and laptop capabilities

Modem Manager (MODMAN/MDU)

- 500 Mbps throughput
- Industrial Modem board design
- ARINC 791 Compliant
- Available mini-server

Source:

https://d1io3yog0oux5.cloudfront.net/anuvu/files/pages/anuvu/db/620/description/AirconnectGlobalKU_Final_ProductSheet+.pdf.

On information and belief, by bonding two 20 MHz channels together, the IEEE 802.11-2016 standard enables 40 MHz capable high throughput (HT) operation, which can support high data rates up to 600 Mb/s.

U.S. Patent No. 8,027,326 (Claim 18)	
Claim 18	Example Southwest Count 4 Systems and Services
	3A. Definitions specific to IEEE 802.11 The following terms and definitions are specific to this standard and are not appropriate for inclusion in the <i>IEEE Standards Dictionary: Glossary of Terms & Definitions</i>.¹ 3A.1 20 MHz basic service set (BSS): A BSS in which the Secondary Channel Offset field is set to SCN. 3A.2 20 MHz high-throughput (HT): A Clause 20 transmission using FORMAT=HT_MF or HT_GF and CH_BANDWIDTH=HT_CBW20. 3A.3 20 MHz mask physical layer convergence procedure (PLCP) protocol data unit (PPDU): A Clause 17 PPDU, a Clause 19 orthogonal frequency division multiplexing (OFDM) PPDU, or a Clause 20 20 MHz high-throughput (HT) PPDU with the TXVECTOR parameter CH_BANDWIDTH set to HT_CBW20 and the CH_OFFSET parameter set to CH_OFF_20. The PPDU is transmitted using a 20 MHz transmit spectral mask defined in Clause 17, Clause 19, or Clause 20, respectively. 3A.4 20 MHz physical layer convergence procedure (PLCP) protocol data unit (PPDU): A Clause 15 PPDU, Clause 17 PPDU, Clause 18 PPDU, Clause 19 orthogonal frequency division multiplexing (OFDM) PPDU, or Clause 20 20 MHz high-throughput (HT) PPDU with the TXVECTOR parameter CH_BANDWIDTH set to HT_CBW20.

U.S. Patent No. 8,027,326 (Claim 18)	
Claim 18	Example Southwest Count 4 Systems and Services
	3A.5 20/40 MHz basic service set (BSS): A BSS in which the supported channel width of the access point (AP) or independent BSS (IBSS) dynamic frequency selection (DFS) owner (IDO) station (STA) is 20 MHz and 40 MHz (Channel Width field is set to 1) and the Secondary Channel Offset field is set to a value of SCA or SCB. 3A.6 40-MHz-capable (FC) high-throughput (HT) access point (AP): An HT AP that included a value of 1 in the Supported Channel Width Set subfield (indicating its capability to operate on a 40 MHz channel) of its most recent transmission of a frame containing an HT Capabilities element. 3A.7 40-MHz-capable (FC) high-throughput (HT) access point (AP) 2G4: An HT AP 2G4 that is also an FC HT AP. 3A.8 40-MHz-capable (FC) high-throughput (HT) access point (AP) 5G: An HT AP 5G that is also an FC HT AP. 3A.9 40-MHz-capable (FC) high-throughput (HT) station (STA): An HT STA that included a value of 1 in the Supported Channel Width Set subfield (indicating its capability to operate on a 40 MHz channel) of its most recent transmission of a frame containing an HT Capabilities element. 3A.10 40-MHz-capable (FC) high-throughput (HT) station (STA) 2G4: An HT STA 2G4 that is also an FC HT STA. 3A.11 40-MHz-capable (FC) high-throughput (HT) station (STA) 5G: An HT STA 5G that is also an FC HT STA. 3A.12 40 MHz high throughput (HT): A Clause 20 transmission using FORMAT=HT_MF or HT_GF and CH_BANDWIDTH=HT_CBW40. Source: IEEE Standard 802.11n-2009 at 3-4.

U.S. Patent No. 8,027,326 (Claim 18)	
Claim 18	Example Southwest Count 4 Systems and Services
	3.2 Definitions specific to IEEE Std 802.11 20/40 MHz basic service set (BSS): A BSS in which the supported channel width of the access point (AP) or dynamic frequency selection (DFS) owner (DO) station (STA) is 20 MHz and 40 MHz (Channel Width field is equal to 1) and the Secondary Channel Offset field is equal to a value of secondary channel above (SCA) or secondary channel below (SCB). 40-MHz-capable (40MC) high-throughput (HT) access point (AP): An HT AP that included a value of 1 in the Supported Channel Width Set subfield (indicating its capability to operate on a 40 MHz channel) of its most recent transmission of a frame containing an HT Capabilities element. Source: IEEE Standard 802.11-2016 at 143.

U.S. Patent No. 8,027,326 (Claim 18)	
Claim 18	Example Southwest Count 4 Systems and Services
	20. High Throughput (HT) PHY specification 20.1 Introduction 20.1.1 Introduction to the HT PHY Clause 20 specifies the PHY entity for a high throughput (HT) orthogonal frequency division multiplexing (OFDM) system. In addition to the requirements found in Clause 20, an HT STA shall be capable of transmitting and receiving frames that are compliant with the mandatory PHY specifications defined as follows: — In Clause 17 when the HT STA is operating in a 20 MHz channel width in the 5 GHz band — In Clause 18 and Clause 19 when the HT STA is operating in a 20 MHz channel width in the 2.4 GHz band The HT PHY is based on the OFDM PHY defined in Clause 17, with extensibility up to four spatial streams, operating in 20 MHz bandwidth. Additionally, transmission using one to four spatial streams is defined for operation in 40 MHz bandwidth. These features are capable of supporting data rates up to 600 Mb/s (four spatial streams, 40 MHz bandwidth). Source: IEEE Standard 802.11n-2009 at 247. 19. High-throughput (HT) PHY specification 19.1 Introduction 19.1.1 Introduction to the HT PHY

U.S. Patent No. 8,027,326 (Claim 18)	
Claim 18	Example Southwest Count 4 Systems and Services
	The HT PHY is based on the OFDM PHY defined in Clause 17, with extensibility up to four spatial streams, operating in 20 MHz bandwidth. Additionally, transmission using one to four spatial streams is defined for operation in 40 MHz bandwidth. These features are capable of supporting data rates up to 600 Mb/s (four spatial streams, 40 MHz bandwidth). Source: IEEE Standard 802.11-2016 at 2334. 40MHz OFDM 802.11N • 802.11n also introduced a 40 MHz channel, which combined two 20 MHz channels • The 40 MHz channel consists of 128 subcarriers: • 128 subcarriers: • 108 transmit data subcarriers • 6 as pilot carriers • 14 unused

U.S. Patent No. 8,027,326 (Claim 18)	
Claim 18	Example Southwest Count 4 Systems and Services
	• When two 20 MHz HT channels are bonded together, some of the formerly unused subcarriers at the bottom of the higher channel and at the top end of the lower channel are able to be used to transmit data. • That is why the number of subcarriers is slightly more than two times the 56 subcarriers in a 20 MHz channel. • Each bonded channel consists of a primary and secondary 20 MHz channel. • The channels must be adjacent. A positive or negative offset indicates whether the secondary channel is the channel above or the channel below the primary channel. This is pictured in Figure 19.4. Source: https://dot11ap.wordpress.com/ht-channel-width-operation/. On information and belief, IEEE 802.11ac infringes for the same reasons as 802.11n. <i>See supra. See also:</i> 4.3.14 Very high throughput (VHT) STA The IEEE 802.11 VHT STA operates in frequency bands below 6 GHz excluding the 2.4 GHz band. A VHT STA is an HT STA that, in addition to features supported as an HT STA, supports VHT features identified in Clause 9, Clause 10, Clause 11, Clause 14, Clause 17, and Clause 21. The main PHY features in a VHT STA that are not present in an HT STA are the following: — Mandatory support for 40 MHz and 80 MHz channel widths — Mandatory support for VHT single-user (SU) PPDU — Optional support for 160 MHz and 80+80 MHz channel widths — Optional support for VHT sounding protocol to support beamforming — Optional support for VHT multi-user (MU) PPDU — Optional support for VHT-MCSs 8 and 9

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Claim 18

Example Southwest Count 4 Systems and Services

Source: IEEE Standard 802.11-2016 at 197.

Table 21-38—VHT-MCSs for mandatory 40 MHz, $N_{SS} = 1$

VHT-MCS Index	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)	
									800 ns GI	400 ns GI (See NOTE)
0	BPSK	1/2	1	108	6	108	54	1	13.5	15.0
1	QPSK	1/2	2	108	6	216	108	1	27.0	30.0
2	QPSK	3/4	2	108	6	216	162	1	40.5	45.0
3	16-QAM	1/2	4	108	6	432	216	1	54.0	60.0
4	16-QAM	3/4	4	108	6	432	324	1	81.0	90.0
5	64-QAM	2/3	6	108	6	648	432	1	108.0	120.0
6	64-QAM	3/4	6	108	6	648	486	1	121.5	135.0
7	64-QAM	5/6	6	108	6	648	540	1	135.0	150.0
8	256-QAM	3/4	8	108	6	864	648	1	162.0	180.0
9	256-QAM	5/6	8	108	6	864	720	1	180.0	200.0
NOTE—Support of 400 ns GI is optional on transmit and receive.										

See also IEEE Standard 802.11-2016 at 2612, where a 40 MHz Modulation and Coding Scheme (MCS) is mandatory.

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Claim 18

Example Southwest Count 4 Systems and Services

Table 21-46—VHT-MCSs for mandatory 80 MHz, $N_{SS} = 1$

VHT-MCS Index	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)	
									800 ns GI	400 ns GI (See NOTE)
0	BPSK	1/2	1	234	8	234	117	1	29.3	32.5
1	QPSK	1/2	2	234	8	468	234	1	58.5	65.0
2	QPSK	3/4	2	234	8	468	351	1	87.8	97.5
3	16-QAM	1/2	4	234	8	936	468	1	117.0	130.0
4	16-QAM	3/4	4	234	8	936	702	1	175.5	195.0
5	64-QAM	2/3	6	234	8	1404	936	1	234.0	260.0
6	64-QAM	3/4	6	234	8	1404	1053	1	263.3	292.5
7	64-QAM	5/6	6	234	8	1404	1170	1	292.5	325.0
8	256-QAM	3/4	8	234	8	1872	1404	1	351.0	390.0
9	256-QAM	5/6	8	234	8	1872	1560	1	390.0	433.3

NOTE—Support of 400 ns GI is optional on transmit and receive.

See also IEEE Standard 802.11-2016 at 2616, where an 80 MHz Modulation and Coding Scheme (MCS) is mandatory.

See also claim 1.

instructions to select at least a first channel and a second channel, wherein the first channel and the second channel are adjacent without

On information and belief, the Southwest Count 4 Systems and Services include a non-transitory computer-readable medium having instructions to select at least a first channel and a second channel, where the first channel and the second channel are adjacent without any other channels therebetween, where the first channel and the second channel each have a plurality of data subcarriers, and where the

U.S. Patent No. 8,027,326 (Claim 18)	
Claim 18	Example Southwest Count 4 Systems and Services
any other channels therebetween, wherein the first channel and the second channel each have a plurality of data subcarriers, wherein the data subcarriers of the first channel and the data subcarriers of the second channel are separated by a frequency gap corresponding to one or more guard bands between the first and second channels;	data subcarriers of the first channel and the data subcarriers of the second channel are separated by a frequency gap corresponding to one or more guard bands between the first and second channels. See claim 1 including claim limitation [1.a].
instructions to partially fill the frequency gap between the first channel and the second channel by adding one or more data subcarriers into the frequency gap such that the one or more guard bands are at least partially filled with at least some of the one or more data subcarriers using full spectral synthesis capability of a fast fourier transform or an inverse fast fourier transform;	On information and belief, the Southwest Count 4 Systems and Services include a non-transitory computer-readable medium having instructions to partially fill the frequency gap between the first channel and the second channel by adding one or more data subcarriers into the frequency gap such that the one or more guard bands are at least partially filled with at least some of the one or more data subcarriers using full spectral synthesis capability of a fast fourier transform or an inverse fast fourier transform. See claim 1 including claim limitation [1.b].

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Claim 18	Example Southwest Count 4 Systems and Services
instructions to combine the first channel and the second channel using channel bonding with orthogonal frequency division multiplexing (OFDM); and	On information and belief, the Southwest Count 4 Systems and Services include a non-transitory computer-readable medium having instructions to combine the first channel and the second channel using channel bonding with orthogonal frequency division multiplexing (OFDM). See claim 1 including claim limitation [1.c].
instructions to transmit data subcarriers occupying the first channel, the second channel, and the frequency gap in parallel to a receiver.	On information and belief, the Southwest Count 4 Systems and Services include a non-transitory computer-readable medium having instructions to transmit data subcarriers occupying the first channel, the second channel, and the frequency gap in parallel to a receiver. See claim 1 including claim limitation [1.d].