

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

BUFFALO PATENTS, LLC,

Plaintiff,

v.

TCL TECHNOLOGY GROUP
CORPORATION, TCL ELECTRONICS
HOLDINGS LIMITED, TCL
COMMUNICATION TECHNOLOGY
HOLDINGS LIMITED, and TCL
COMMUNICATION LIMITED,

Defendants.

CIVIL ACTION NO. 6:21-cv-1064

ORIGINAL COMPLAINT FOR
PATENT INFRINGEMENT

JURY TRIAL DEMANDED

ORIGINAL COMPLAINT FOR PATENT INFRINGEMENT

Plaintiff Buffalo Patents, LLC (“Buffalo Patents” or “Plaintiff”) files this original complaint against Defendants TCL Technology Group Corporation, TCL Electronics Holdings Limited, TCL Communication Technology Holdings Limited, and TCL Communication Limited (collectively, “TCL” or “Defendants”), alleging, based on its own knowledge as to itself and its own actions and based on information and belief as to all other matters, as follows:

PARTIES

1. Buffalo Patents is a limited liability company formed under the laws of the State of Texas, with its principal place of business at 1200 Silver Hill Dr., Austin, Texas, 78746.

2. Defendant TCL Technology Group Corporation (“TCL Technology”) is a company duly organized and existing under the laws of the People’s Republic of China, having an address of No. 26, the Third Road, Zhongkai Avenue, Huizhou City, Guangdong, China 516006. TCL Technology may also be served with process by serving the Texas Secretary of State, 1019 Brazos Street, Austin, Texas 78701, as its agent for service because it engages in

business in Texas but has not designated or maintained a resident agent for service of process in Texas as required by statute. This action arises out of that business.

3. TCL Technology—together with its subsidiaries—describes itself as “principally engag[ing] in the R&D, manufacturing and sales of consumer electronic products such as smart screens, mobile communication devices and independently develop[ing] home Internet services.”¹

4. Defendant TCL Electronics Holdings Limited (“TCL Electronics”) is a limited liability company duly organized and existing under the laws of the Cayman Islands, having an address of 7th Floor, Building 22E, 22 Science Park East Avenue, Hong Kong Science Park, Shatin, New Territories, Hong Kong. TCL Electronics may also be served with process by serving the Texas Secretary of State, 1019 Brazos Street, Austin, Texas 78701, as its agent for service because it engages in business in Texas but has not designated or maintained a resident agent for service of process in Texas as required by statute. This action arises out of that business.

5. TCL Electronics is an indirect wholly-owned subsidiary of TCL Technology. TCL Electronics is involved in the manufacture and sale of TVs, smart mobile phones, smart connective devices and services, smart commercial display and smart home products and provision of Internet platform operating services.²

6. Defendant TCL Communication Technology Holdings Limited (“TCL Communication”) is a company duly organized and existing under the laws of the Cayman Islands, having an address of 5th Floor, Building 22E, 22 Science Park East Avenue, Hong Kong

¹ TCL Electronics Holdings Limited Annual Report 2020, at 3, <https://doc.irasia.com/listco/hk/tclelectronics/annual/2020/ar2020.pdf>.

² *See supra* note 1, at 139.

Science Park, Shatin, New Territories, Hong Kong. TCL Communication may also be served with process by serving the Texas Secretary of State, 1019 Brazos Street, Austin, Texas 78701, as its agent for service because it engages in business in Texas but has not designated or maintained a resident agent for service of process in Texas as required by statute. This action arises out of that business.

7. TCL Communication is a wholly owned subsidiary of TCL Electronics, which is an indirectly wholly owned subsidiary of TCL Technology. Together with its subsidiaries, TCL Communication manufactures and sells smart mobile phones and connective devices, and provides related services.

8. Defendant TCL Communication Limited (“TCLC”) is a corporation duly organized and existing under the laws of the People’s Republic of China, having an address of 7/F, Block F4, TCL International E City Zhong Shan Yuan Road, Nanshan District, Shenzhen China. TCLC may also be served with process by serving the Texas Secretary of State, 1019 Brazos Street, Austin, Texas 78701, as its agent for service because it engages in business in Texas but has not designated or maintained a resident agent for service of process in Texas as required by statute. This action arises out of that business.

9. TCLC is an indirect subsidiary of TCL Technology. TCLC is involved in the manufacture and sale of smart mobile phones and connective devices, and in the provision of related services

10. The Defendants identified in paragraphs 2–9 above (collectively, “TCL”) are part of an interrelated group of companies which together comprise one of the world’s largest manufacturers of televisions and smartphones and one of the leading sellers of televisions and smartphones in the United States, including the TCL brands. TCL, which refers to the company

and its subsidiaries as the “Group,” describes itself as one of the “world’s leading consumer electronics company”³ and states that the Group is “mainly involved in the manufacture and sale of television (‘TV’) sets, smart mobile, smart connective devices and services, smart commercial display and smart home products and provision of Internet platform operating services.”⁴

11. The TCL defendants named above and their affiliates are part of the same corporate structure and distribution chain for the making, importing, offering to sell, selling, and using of the accused devices in the United States, including in the State of Texas generally and this judicial district in particular.

12. The TCL defendants named above and their affiliates share the same management, common ownership, advertising platforms, facilities, distribution chains and platforms, and accused product lines and products involving related technologies.

13. Thus, the TCL defendants named above and their affiliates operate as a unitary business venture and are jointly and severally liable for the acts of patent infringement alleged herein.

14. The parties to this action are properly joined under 35 U.S.C. § 299 because the right to relief asserted against defendants jointly and severally arises out of the same series of transactions or occurrences relating to the making and using of the same products or processes. Additionally, questions of fact common to all defendants will arise in this action.

³ *See supra* note 1, at 3.

⁴ *See supra* note 1, at 139.

JURISDICTION AND VENUE

15. This is an action for infringement of United States patents arising under 35 U.S.C. §§ 271, 281, and 284–85, among others. This Court has subject matter jurisdiction of the action under 28 U.S.C. § 1331 and § 1338(a).

16. This Court has personal jurisdiction over Defendants pursuant to due process and/or the Texas Long Arm Statute because, *inter alia*, (i) Defendants have done and continue to do business in Texas and (ii) Defendants have committed and continue to commit acts of patent infringement in the State of Texas, including making, using, offering to sell, and/or selling accused products in Texas, and/or importing accused products into Texas, including by Internet sales and sales via retail and wholesale stores, inducing others to commit acts of patent infringement in Texas, and/or committing a least a portion of any other infringements alleged herein. In addition, or in the alternative, this Court has personal jurisdiction over Defendants pursuant to Fed. R. Civ. P. 4(k)(2).

17. Venue is proper in this district pursuant to 28 U.S.C. §§ 1391(b), 1391(c), and 1400(b) because (i) Defendants have done and continue to do business in this district; (ii) Defendants have committed and continue to commit acts of patent infringement in this district, including making, using, offering to sell, and/or selling accused products in this district, and/or importing accused products into this district, including by internet sales and sales via retail and wholesale stores, and/or inducing others to commit acts of patent infringement in this district; and (iii) Defendants are foreign entities.

18. Venue is proper as to Defendants, each of which is organized under the laws of a foreign jurisdiction. 28 U.S.C. § 1391(c)(3) provides that “a defendant not resident in the United States may be sued in any judicial district, and the joinder of such a defendant shall be

disregarded in determining where the action may be brought with respect to other defendants.”
See also In re HTC Corp., 889 F.3d 1349 (Fed. Cir. 2018).

BACKGROUND

19. The patents-in-suit generally relate to internet and wireless network telephony. They disclose methods and systems for transmitting voice information to an end user in a digital format based on a network protocol (such as Wi-Fi or IEEE 802.11). The patented technology is used in smartphones and other devices for Voice over Wi-Fi calling (VoWi-Fi). The technology allows a user to place a call over private networks, such as WLANs (IEEE 802.11 wireless local area networks), home Wi-Fi networks, and public Wi-Fi hotspots.

20. The technology disclosed by the patents-in-suit was developed by engineers at the Danish company Nextlink.to A/S in the late 1990s. Nextlink began operations in 1999 and its roots originate from “The Danish Sound,” an international industry cluster with a long tradition of technological achievements in acoustics, hearing, and mobile communication based on research and collaboration between businesses and universities.⁵ In the early 2000s, Nextlink developed the smallest Bluetooth headset in the world, which was presented at the IBC Bluetooth Congress in Monte Carlo in 2001.⁶ In 2008, the company changed its name to Invisio Headsets AB and streamlined the business to focus on communication solutions for professional

⁵ *See* INVISIO Annual Report 2018, at 26, <https://invisio.com/media/1358/invisio-communications-annual-report-2018.pdf>; *see also* <https://invisio.com/about/history> (“Denmark has a long tradition of world-leading technology in hearing and acoustics with products from hearing aids to headsets and loudspeakers.”)

⁶ <https://web.archive.org/web/20010721094402/http://www.nextlink.to/>.

users.⁷ The current company, INVISIO, develops advanced communication systems that help professionals in mission critical environments to communicate and work more effectively.⁸

21. The inventions disclosed in the patents-in-suit have been cited during patent prosecution multiple times by leading technology companies in the telecommunications industry, including ADC Telecom (now TE Connectivity), AT&T, Fujitsu, General Instrument Corp. (now Motorola Mobility), GN Group, Huawei, iGo, Koninklijke Philips, NVIDIA, Samsung, Sennheiser, Sony, and Sprint.

COUNT I

DIRECT INFRINGEMENT OF U.S. PATENT NO. 7,187,670

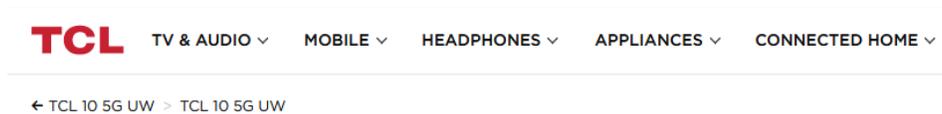
22. On March 6, 2007, United States Patent No. 7,187,670 (“the ’670 Patent”) was duly and legally issued by the United States Patent and Trademark Office for an invention entitled “Communications Terminal, a System and a Method for Internet/Network Telephony.”

23. Buffalo Patents is the owner of the ’670 Patent, with all substantive rights in and to that patent, including the sole and exclusive right to prosecute this action and enforce the ’670 Patent against infringers, and to collect damages for all relevant times.

24. TCL made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its TCL 10 5G UW Smartphone and other products that support Voice over Wi-Fi (VoWi-Fi) or Wi-Fi calling (“accused products”):

⁷ *Id.*

⁸ See <https://invisio.com>.



Source: <https://www.tcl.com/us/en/products/mobile/tcl-10-5g-uw/t790s>

25. By doing so, TCL has directly infringed (literally and/or under the doctrine of equivalents) at least Claim 1 of the '670 Patent. TCL's infringement in this regard is ongoing.

26. The TCL 10 5G UW Smartphone is an exemplary accused product.

27. A TCL 10 5G UW device is an electronic portable communications terminal for network telephony. It includes audio means for reproducing sound on the basis of a first electrical signal and to record sound resulting in a second electrical signal.

28. For example, a TCL 10 5G UW device supports Wi-Fi calling/Voice over Wi-Fi (VoWi-Fi). VoWi-Fi enables a user to make and receive calls over the internet. A TCL 10 5G UW device includes a microphone and a speaker ("audio means") to detect sounds generated by the user and to generate sounds based on voice data, respectively.

29. As one example, when a calling party establishes a call using the VoWi-Fi feature, the sound waves generated by the calling party are converted into analog electrical signals ("second electrical signal") by the microphone.

30. The voice data received at the calling party's device is processed to generate analog voice signals ("first electrical signal") which are fed to the speaker to generate or reproduce sound.

MODEL T790S

TCL 10 5G UW - T790S

Suggested Price
\$399.99

WHERE TO BUY

- 6.53" FHD+ display with dedicated display engine for enhanced visuals.
- Qualcomm® Snapdragon™ 765, Octa-core processor, and 6GB of RAM for smooth performance.
- 5G connectivity for super-fast gaming, streaming, and video calling.
- Up to 128GB of internal memory, expandable up to an additional 256GB via optional microSD™ card.
- Triple rear cameras with dual LED flash: 48MP (main) + 8MP (super wide-angle) + 5MP (macro)
- 16MP front-facing camera with 4-in-1 big pixel technology for brighter selfies.
- Fast-charging 4500 mAh battery with OTG reverse charging capability.
- Fingerprint sensor and face unlock for fast and secure access.

DIAMOND GRAY
\$399.99

Source: <https://www.tcl.com/us/en/products/mobile/tcl-10-5g-uw/t790s>

TCL 10 5G UW - Turn Wi-Fi Calling On / Off

When turned on, Wi-Fi Calling may improve call quality while indoors.

Notes:

- For Wi-Fi Calling to work, verify:
 - Wi-Fi is turned on and connected.
 - HD Voice is activated first while in the Verizon wireless coverage area (can't be activated internationally).

Source: <https://www.verizon.com/support/knowledge-base-235666/>

What is Voice over Wi-Fi?

Voice over Wi-Fi (VoWi-Fi) refers to the use of IEEE 802.11 wireless LANs (WLANs) to transport Voice over IP (VoIP) traffic. The technology has consumer, business and service provider applications. It is used over private WLANs, home Wi-Fi networks and public Wi-Fi hotspots.

Source: <https://ribboncommunications.com/company/get-help/glossary/voice-over-wi-fi>

Microphone

The microphone changes the sound waves from your voice into electrical signals that are sent to the audio amplifier of the radio components. A microphone is essentially a speaker that works in reverse. When sound waves from your voice move the membrane, they make tiny electric currents either by moving a coil of wire within a magnet or by compressing the membrane against carbon dust (see [How do microphones work?](#) for details).

Source: <https://electronics.howstuffworks.com/cordless-telephone4.htm>

One common application for CODECs is with Digital Signal Processors (DSPs) in audio electronics devices. CODECs convert sound (using the ADC) to digital signals for a processor to compress and store and for playback, the stored digital data is decompressed and converted to analog signals via the DAC. The analog signal reaches the human ear by converting the analog signal into a transmissible sound via a pulse width modulator and a speaker, for example.

Source: <https://www.analogictips.com/what-is-a-codec/>



Source: <https://ss7.vzw.com/is/content/VerizonWireless/tcl-10-5g-uw-en-userguide-10212020>

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31. A TCL 10 5G UW device includes a converting means converting said second electrical signal into transmission data, representing sound for transmission, in a suitable data format, and to convert received data, representing received sound, in said suitable data format into said first electrical signal.

32. For example, a TCL 10 5G UW device supports Wi-Fi calling/Voice over Wi-Fi (VoWi-Fi). VoWi-Fi enables a user to make and receive calls over the internet. A TCL 10 5G UW device includes a codec (coder/decoder) (“converting means”) to convert analog voice input into digital data and vice versa.

33. As one example, when a calling party establishes a call using the VoWi-Fi feature, the electrical signal generated by the microphone (“second electrical signal”) is converted into digital data (“transmission data, representing sound for transmission, in a suitable data format”) with the help of a codec.

34. Further, packetized voice data received at the calling party’s device is processed and converted into digital data. This digital data (“received data, representing received sound, in said suitable data format”) is fed to the codec to generate an analog voice signal (“first electrical signal”).

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Source: <https://ribboncommunications.com/company/get-help/glossary/voice-over-wi-fi>

3. Codecs

The quality of voice is a characteristic on digital telephony. Since VoIP and VoWiFi combine digital telephony and networking technologies they also have the quality of voice characteristic. An important element that controls the quality of voice is the compression, and conversion of analog to digital (codec) used on the voice traffic. There are numerous codecs defined for use with voice traffic. The following sections will introduce and give an overview of a few current codecs in use.

Source: https://www.cse.wustl.edu/~jain/cse574-06/ftp/wireless_voip/index.html

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Source: <https://www.analogictips.com/what-is-a-codec/>

Baseband part in a mobile is comprised of a digital signal processor (DSP) to process forward voice/data signals for transmission and to process reverse voice/data signals received.

This is the core processing part which changes for various air interface standards like GSM, HSPA, LTE and more. It is often named as physical layer or Layer 1 or L1. For Speech/audio, codec is used to compress and decompress the signal to match the data rate to the frame it has to fit in. The baseband or physical layer will add redundant bits to enable error detection as well as error correction. Error detection is obtained with CRC and error correction with forward error correction techniques. Other than this interleaving is done for the data of one burst which helps in spreading the error over the time hence helps receiver de-interleave and decode the frame (consecutively data burst) correctly.

Source: <https://www.techplayon.com/mobile-phone-architecture/#:~:text=Baseband%20part%20in%20a%20mobile,%2C%20HSPA%2C%20LTE%20and%20more>



Source: <https://ss7.vzw.com/is/content/VerizonWireless/tcl-10-5g-uw-en-userguide-10212020>
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35. A TCL 10 5G UW device includes a protocol means connected to said converting means for handling and controlling communication of said received and transmission data in accordance with a standardized network protocol, thereby embedding and extracting said transmission and received data, respectively, in/from a data packet format according to said standardized network protocol.

36. For example, a TCL 10 5G UW device supports Wi-Fi calling/Voice over Wi-Fi (VoWi-Fi). VoWi-Fi enables a user to make and receive calls over the internet.

37. As one example, when a calling party establishes a call using the VoWi-Fi feature, the voice input is converted into digital voice data and the digital voice data is split and encapsulated (“thereby embedding”) into IP (Internet Protocol) packets (“data packet format”) by the device.

38. Further, when voice data is received at the calling party's device, the data is processed and the IP packets (encapsulated data), including the packetized voice data, are extracted. The IP packets correspond to the IP protocol ("standardized network protocol"). The TCL 10 5G UW device includes a processor ("protocol means") for embedding and extracting the digital data into/from IP packets, respectively.

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Source: <https://www.verizon.com/support/knowledge-base-235666/>

What is VoWiFi?

Voice over Wi-Fi (VoWiFi), as the name implies, is delivering voice service via WiFi network. Users can make calls without the need of mobile signal. VoWiFi is a complementary technology to Voice over LTE (VoLTE). Both make use of the IP Multimedia Subsystem (IMS) technology to realize the voice traffic as IP packets.

Source: <https://insinuator.net/2016/10/a-journey-into-the-depths-of-vowifi-security/>

Transport Layer (Layer 4)

Transport layer adds many information with original data as Transport layer header (Layer 4 header), which are relevant for data processing at the Transport layer.

The Application layer message is encapsulated at the Transport layer. If the protocol used at the Transport Layer is TCP (Transmission Control Protocol), the data packet is known as "TCP Segment". If the protocol used at the Transport layer is UDP (User Datagram Protocol), the data packet is known as "UDP Datagram".

Network Layer (Layer 3)

Network layer adds additional data as header, which are relevant for processing data at Network layer.

The data packet created at the Network layer by Internet Protocol (IPv4 or IPv6), which encapsulates its upper layer Transport layer segment/datagram, is known as "IP Datagram".

Source: <https://www.omniseccu.com/tcpip/tcpip-encapsulation-decapsulation.php>

Datalink Layer (Layer 2)

Receiver opens the Datalink layer header and trailer (Layer 2 header and trailer), uses the values at Datalink header and trailer for processing data at the Datalink layer.

Receiver then collects the Network layer packet (IPv4 or IPv6 Datagram), and it is transferred to Network layer for further processing.

Source: <https://www.omniseccu.com/tcpip/tcpip-encapsulation-decapsulation.php>

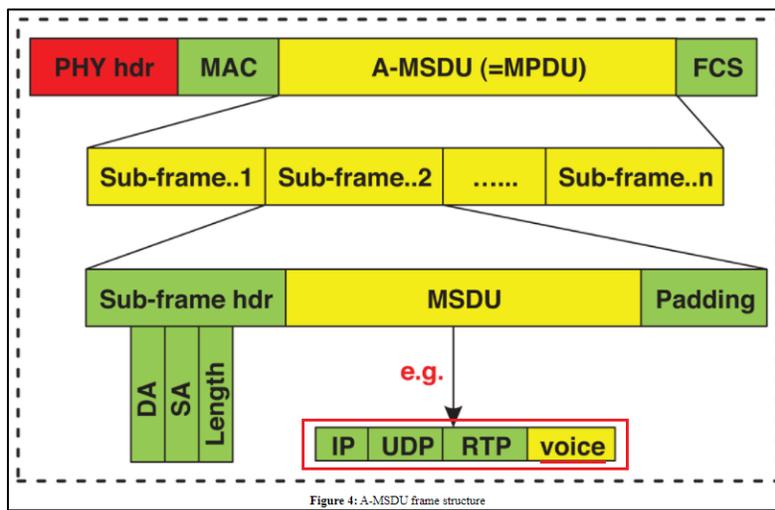


Figure 4: A-MSDU frame structure

Source: <https://www.techscience.com/cmc/v66n2/40658/html>

39. A TCL 10 5G UW device includes a wireless near field communications means connected to said protocol means for receiving/sending said received and transmission data in said first data packet format from/to said protocol means. The near field communications means embeds said transmission data in said first data packet format received from said protocol means

in a wireless second data format and extracts said received data in said first data packet format from said wireless second data format.

40. For example, a TCL 10 5G UW device supports Wi-Fi calling/Voice over Wi-Fi (VoWi-Fi). VoWi-Fi enables a user to make and receive calls over the internet. As one example, when a calling party establishes a call using the VoWi-Fi feature, the voice input is processed and encapsulated into IP packets (“first data packet format”) by the device. Further, when voice data is received at the calling party’s device, the data is processed and the encapsulated IP packets, including the packetized voice data, are extracted. The TCL 10 5G UW device includes a processor (“protocol means”) for embedding and extracting the digital data into/from IP packets, respectively.

41. The IP packets (“in said first data packet format”) received from the protocol means are then embedded into PPDU (PLCP (Physical Layer Convergence Protocol) protocol Data Unit) frames by adding appropriate headers, such as Physical layer and MAC layer headers. The TCL 10 5G UW includes a Wi-Fi chipset (“wireless near field communication means”) for embedding the IP packets into the IEEE 802.11 frame format (PPDUs) (“wireless second data format”).

42. When the calling party receives the voice data (PPDUs) from the wireless network, the embedded IP packets are extracted from these PPDU frames by the removal of appropriate headers. The received PPDU frames correspond to the IEEE 802.11 protocol. The extracted IP packets including the packetized voice data are then sent to the protocol means for processing. The Wi-Fi chipset (“wireless near field communication means”) extracts the IP packets from the received PPDUs and sends them to the protocol means.

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Voice over Wi-Fi (VoWiFi), as the name implies, is delivering voice service via WiFi network. Users can make calls without the need of mobile signal. VoWiFi is a complementary technology to Voice over LTE (VoLTE). Both make use of the IP Multimedia Subsystem (IMS) technology to realize the voice traffic as IP packets.

Source: <https://insinuator.net/2016/10/a-journey-into-the-depths-of-vowifi-security/>

Datalink layer (Layer 2)

The data packet generated at **Network layer** is then placed inside Datalink layer header and trailer (Layer 2 header and trailer). Values inside Datalink layer header and trailer are relevant for processing data at **Datalink layer**.

The data packet at the **Datalink layer**, which encapsulates and may subdivide the **IP Datagram**, is known as a "**Frame**" (generally **Ethernet Frame**).

The most important values at Datalink layer header (Layer 2 header) are source and destination MAC addresses (Layer 2 addresses). Following image represents data packet generated at **Datalink layer**.

Source: <https://www.omniseku.com/tcpip/tcpip-encapsulation-decapsulation.php>

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Receiver opens the Datalink layer header and trailer (Layer 2 header and trailer), uses the values at **Datalink header and trailer** for processing data at the **Datalink layer**.

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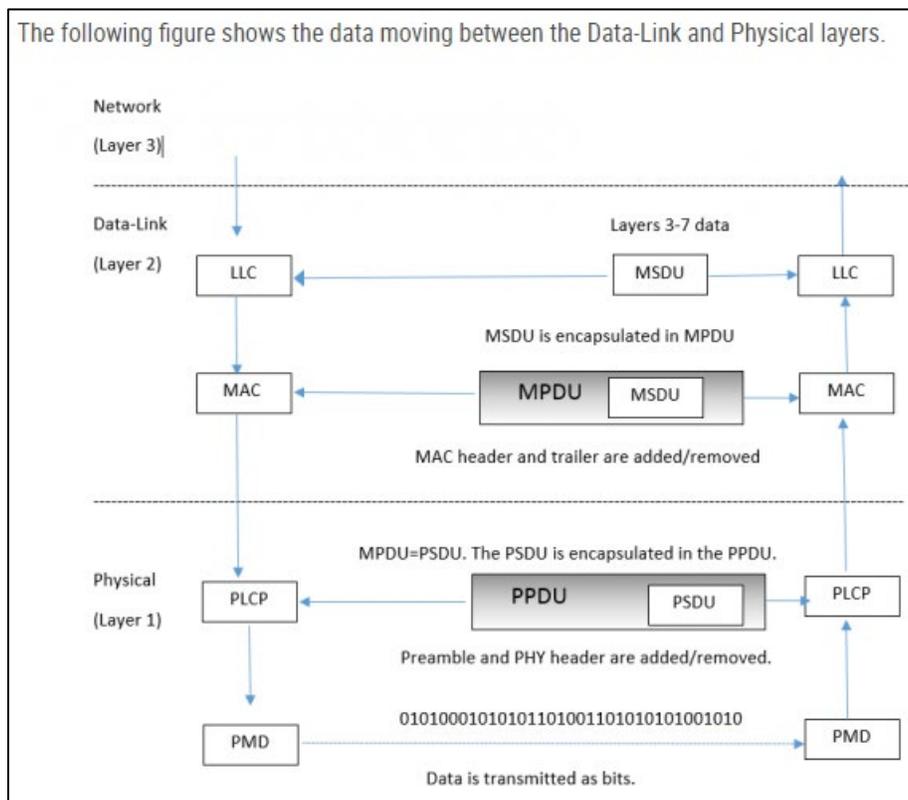
Source: <https://www.omniseku.com/tcpip/tcpip-encapsulation-decapsulation.php>

physical layer (PHY) protocol data unit (PPDU): The unit of data exchanged between two peer PHY entities to provide the PHY data service.

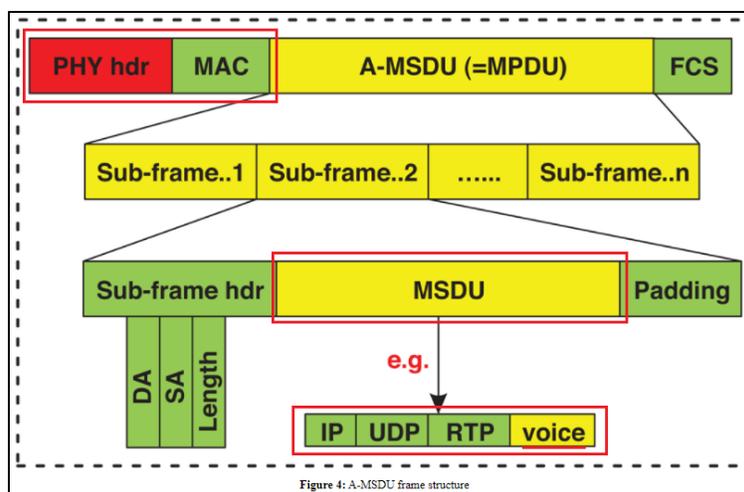
Source: <https://ieeexplore.ieee.org/document/7786995> (Page 138)

- When the Network layer (layer 3) sends data to the Data-Link layer, that data is handed off to the LLC and becomes known as the MAC Service Data Unit (MSDU).
- The payload of a 802.11 data frame is the layer 3-7 information known as the MSDU.
- A simple definition of the MSDU is that it is the data payload that contains the IP packet plus some LLC data.

Source: <https://dot11ap.wordpress.com/msdu-and-mpdu/>



Source: <https://www.cwnp.com/802.11-mac-series-ndash-basics-mac-architecture-ndash-part-1-3/>



Source: <https://www.techscience.com/cmc/v66n2/40658/html>

43. The wireless near field communications means performs wireless near field communication of said received data or said transmission data embedded in said wireless second data format with a connecting unit communicating in said wireless second data format and to establish a connection to a network according to said standardized network protocol, whereby the resulting data exchanged between the wireless near field communication means and the connecting unit consist of packets in said first data packet format embedded in said wireless second data format.

44. For example, a TCL 10 5G UW device supports Wi-Fi calling/Voice over Wi-Fi (VoWi-Fi). VoWi-Fi enables a user to make and receive calls over the internet. As one example, when a calling party establishes a call using the VoWi-Fi feature, the calling party's device embeds the digital voice data into IP packets. These IP packets ("said first data packet format") are then embedded into PPDUs frames by adding appropriate headers, such as Physical layer and MAC layer headers. The TCL 10 5G UW device includes a Wi-Fi chipset ("wireless near field communication means") for embedding the IP packets into IEEE 802.11 frame format (i.e., PPDUs) ("wireless second data format").

45. The Wi-Fi chipset (“wireless near field communication means”) of the device transmits the PPDUs (“transmission data embedded in wireless second data format”) to the 802.11 router/access point (“connecting unit”) using corresponding wireless communication antennas. The Wi-Fi chipset (“wireless near field communication means”) of the device also receives PPDUs (“received data”) from the 802.11 router/access point (“connecting unit”) using corresponding wireless communication antennas. These PPDUs correspond to IEEE 802.11 frame format (“wireless second data format”) and include the embedded IP (“first data packet format”) packets with packetized voice data.

46. The 802.11 access points are connected to the internet according to the Internet Protocol (“standardized network protocol”).

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The most important values at Datalink layer header (Layer 2 header) are source and destination **MAC addresses (Layer 2 addresses)**. Following image represents data packet generated at **Datalink layer**.

Source: <https://www.omniseccu.com/tcpip/tcpip-encapsulation-decapsulation.php>

Datalink Layer (Layer 2)

Receiver opens the **Datalink layer header and trailer (Layer 2 header and trailer)**, uses the values at **Datalink header and trailer** for processing data at the **Datalink layer**.

Receiver then collects the Network layer packet (IPv4 or IPv6 Datagram), and it is transferred to **Network layer** for further processing.

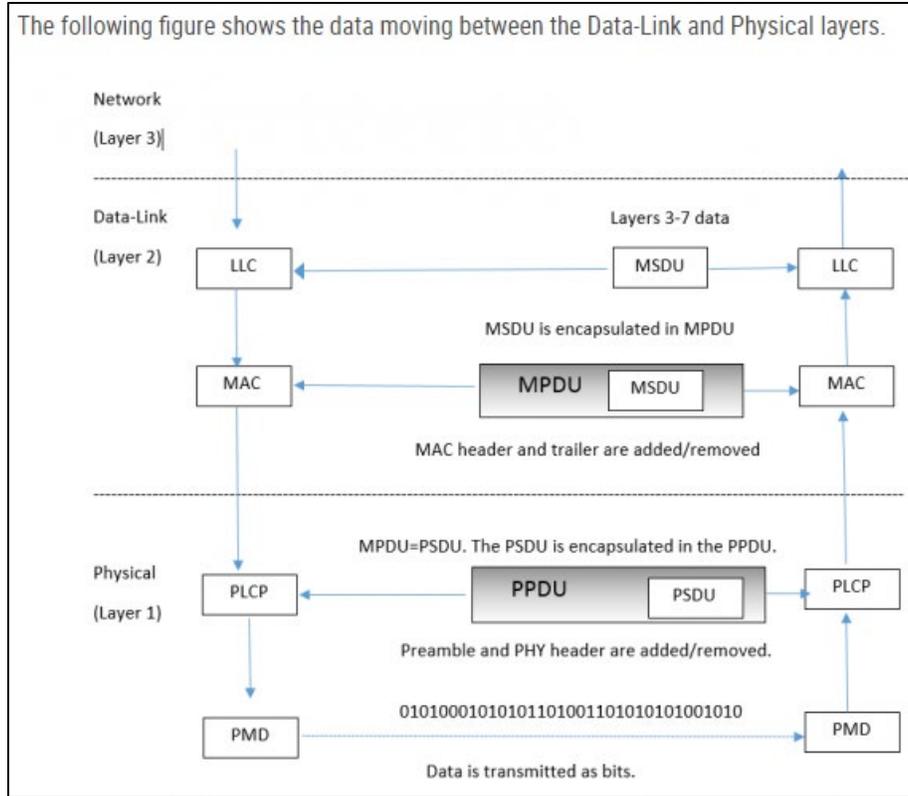
Source: <https://www.omniseccu.com/tcpip/tcpip-encapsulation-decapsulation.php>

physical layer (PHY) protocol data unit (PPDU): The unit of data exchanged between two peer PHY entities to provide the PHY data service.

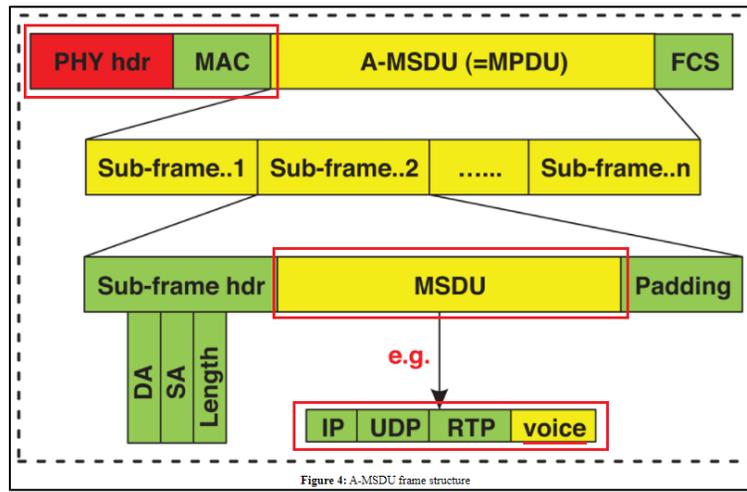
Source: <https://ieeexplore.ieee.org/document/7786995> (Page 138)

- When the Network layer (layer 3) sends data to the Data-Link layer, that data is handed off to the LLC and becomes known as the MAC Service Data Unit (MSDU).
- The payload of a 802.11 data frame is the layer 3-7 information known as the MSDU.
- A simple definition of the MSDU is that it is the data payload that contains the IP packet plus some LLC data.

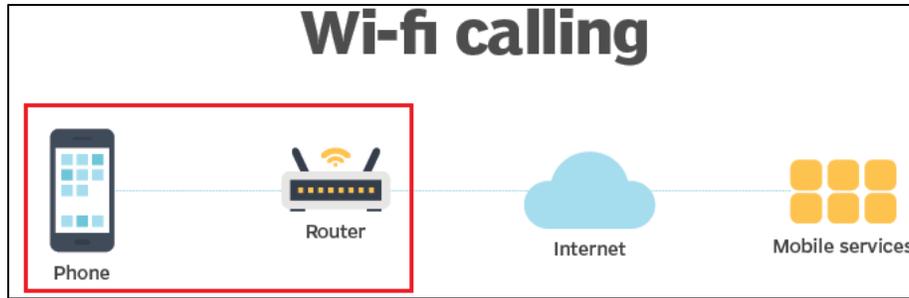
Source: <https://dot11ap.wordpress.com/msdu-and-mpdu/>



Source: <https://www.cwnp.com/802.11-mac-series-ndash-basics-mac-architecture-ndash-part-1-3/>



Source: <https://www.techscience.com/cmc/v66n2/40658/html>



Source: <https://whatis.techtarget.com/definition/Wi-Fi-calling>



Source: <https://www.cspprotocol.com/what-is-wifi-calling/>

47. TCL has had knowledge of the '670 Patent at least as of the date when it was notified of the filing of this action.

48. Buffalo Patents has been damaged as a result of the infringing conduct by TCL alleged above. Thus, TCL is liable to Buffalo Patents in an amount that adequately compensates it for such infringements, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

49. Buffalo Patents has neither made nor sold unmarked articles that practice the '670 Patent, and is entitled to collect pre-filing damages for the full period allowed by law for infringement of the '670 Patent.

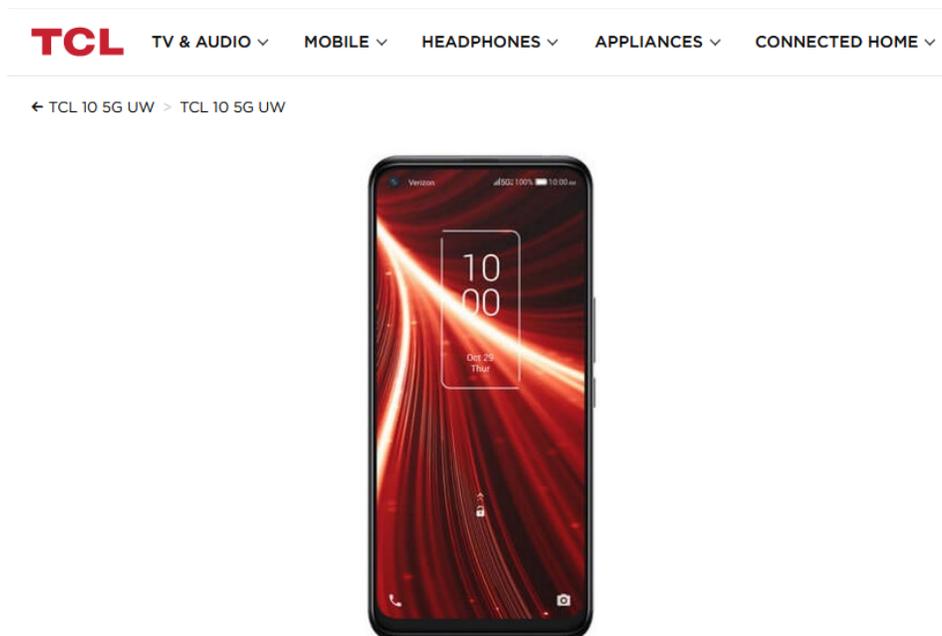
COUNT II

DIRECT INFRINGEMENT OF U.S. PATENT NO. 7,408,915

50. On August 5, 2008, United States Patent No. 7,408,915 (“the ’915 Patent”) was duly and legally issued by the United States Patent and Trademark Office for an invention entitled “Communications Terminal, a System and a Method for Internet/Network Telephony.”

51. Buffalo Patents is the owner of the ’915 Patent, with all substantive rights in and to that patent, including the sole and exclusive right to prosecute this action and enforce the ’915 Patent against infringers, and to collect damages for all relevant times.

52. TCL made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its TCL 10 5G UW Smartphone and other products that support Voice over Wi-Fi (VoWi-Fi) or Wi-Fi calling (“accused products”):



Source: <https://www.tcl.com/us/en/products/mobile/tcl-10-5g-uw/t790s>

53. By doing so, TCL has directly infringed (literally and/or under the doctrine of equivalents) at least Claim 29 of the '915 Patent. TCL's infringement in this regard is ongoing.

54. The TCL 10 5G UW Smartphone is an exemplary accused product.

55. TCL has infringed the '915 Patent by using the accused products and thereby practicing a method for network telephony comprising the step of reproducing sound on the basis of a first electrical signal and recording sound resulting in a second electrical signal, by audio means.

56. For example, a TCL 10 5G UW device supports Wi-Fi calling/Voice over Wi-Fi (VoWi-Fi). VoWi-Fi enables a user to make and receive calls over the internet. A TCL 10 5G UW device includes a microphone and a speaker ("audio means") to detect sounds generated by the user and to generate sounds based on voice data, respectively.

57. As one example, when a calling party establishes a call using the VoWi-Fi feature, the sound waves generated by the calling party are converted into analog electrical signals ("second electrical signal") by the microphone.

58. Further, voice data received at the calling party's device is processed to generate analog voice signals ("first electrical signal"), which are fed to the speaker to generate or reproduce sound.

MODEL T790S

TCL 10 5G UW - T790S

Suggested Price
\$399.99

WHERE TO BUY

- 6.53" FHD+ display with dedicated display engine for enhanced visuals.
- Qualcomm® Snapdragon™ 765, Octa-core processor, and 6GB of RAM for smooth performance.
- 5G connectivity for super-fast gaming, streaming, and video calling.
- Up to 128GB of internal memory, expandable up to an additional 256GB via optional microSD™ card.
- Triple rear cameras with dual LED flash: 48MP (main) + 8MP (super wide-angle) + 5MP (macro)
- 16MP front-facing camera with 4-in-1 big pixel technology for brighter selfies.
- Fast-charging 4500 mAh battery with OTG reverse charging capability.
- Fingerprint sensor and face unlock for fast and secure access.

DIAMOND GRAY
\$399.99

Source: <https://www.tcl.com/us/en/products/mobile/tcl-10-5g-uw/t790s>

TCL 10 5G UW - Turn Wi-Fi Calling On / Off

When turned on, Wi-Fi Calling may improve call quality while indoors.

Notes:

- For Wi-Fi Calling to work, verify:
 - Wi-Fi is turned on and connected.
 - HD Voice is activated first while in the Verizon wireless coverage area (can't be activated internationally).

Source: <https://www.verizon.com/support/knowledge-base-235666/>

What is Voice over Wi-Fi?

Voice over Wi-Fi (VoWi-Fi) refers to the use of IEEE 802.11 wireless LANs (WLANs) to transport Voice over IP (VoIP) traffic. The technology has consumer, business and service provider applications. It is used over private WLANs, home Wi-Fi networks and public Wi-Fi hotspots.

Source: <https://ribboncommunications.com/company/get-help/glossary/voice-over-wi-fi>

Microphone

The microphone changes the sound waves from your voice into electrical signals that are sent to the audio amplifier of the radio components. A microphone is essentially a speaker that works in reverse. When sound waves from your voice move the membrane, they make tiny electric currents either by moving a coil of wire within a magnet or by compressing the membrane against carbon dust (see [How do microphones work?](#) for details).

Source: <https://electronics.howstuffworks.com/cordless-telephone4.htm>

One common application for CODECs is with Digital Signal Processors (DSPs) in audio electronics devices. CODECs convert sound (using the ADC) to digital signals for a processor to compress and store and for playback, the stored digital data is decompressed and converted to analog signals via the DAC. The analog signal reaches the human ear by converting the analog signal into a transmissible sound via a pulse width modulator and a speaker, for example.

Source: <https://www.analogictips.com/what-is-a-codec/>



Source: <https://ss7.vzw.com/is/content/VerizonWireless/tcl-10-5g-uw-en-userguide-10212020>

(Page 28)

59. The method practiced using the accused products further comprises the step of converting said second electrical signal into transmission data, representing sound for transmission, in a suitable data format, and converting received data, representing received sound, in said suitable data format into said first electrical signal, by converting means.

60. For example, a TCL 10 5G UW device supports Wi-Fi calling/Voice over Wi-Fi (VoWi-Fi). VoWi-Fi enables a user to make and receive calls over the Internet. A TCL 10 5G UW device includes a codec (coder/decoder) (“converting means”) to convert analog voice input into digital data and vice versa.

61. As one example, when a calling party establishes a call using the VoWi-Fi feature, the electrical signal generated by the microphone (“second electrical signal”) is converted into digital data (“transmission data, representing sound for transmission, in a suitable data format”) with the help of the codec.

62. Further, packetized voice data received at the calling party’s device is processed and converted to digital data. The digital data (“representing received sound, in said suitable data format”) is further fed to the codec to generate an analog voice signal (“first electrical signal”).

TCL 10 5G UW - Turn Wi-Fi Calling On / Off

When turned on, Wi-Fi Calling may improve call quality while indoors.

🗨 Notes:

- For Wi-Fi Calling to work, verify:
 - Wi-Fi is turned on and connected.
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What is Voice over Wi-Fi?

Voice over Wi-Fi (VoWi-Fi) refers to the use of IEEE 802.11 wireless LANs (WLANs) to transport Voice over IP (VoIP) traffic. The technology has consumer, business and service provider applications. It is used over private WLANs, home Wi-Fi networks and public Wi-Fi hotspots.

Source: <https://ribboncommunications.com/company/get-help/glossary/voice-over-wi-fi>

3. Codecs

The quality of voice is a characteristic on digital telephony. Since VoIP and VoWiFi combine digital telephony and networking technologies they also have the quality of voice characteristic. An important element that controls the quality of voice is the compression, and conversion of analog to digital (codec) used on the voice traffic. There are numerous codecs defined for use with voice traffic. The following sections will introduce and give an overview of a few current codecs in use.

Source: https://www.cse.wustl.edu/~jain/cse574-06/ftp/wireless_voip/index.html

One common application for CODECs is with Digital Signal Processors (DSPs) in audio electronics devices. CODECs convert sound (using the ADC) to digital signals for a processor to compress and store and for playback, the stored digital data is decompressed and converted to analog signals via the DAC. The analog signal reaches the human ear by converting the analog signal into a transmissible sound via a pulse width modulator and a speaker, for example.

Source: <https://www.analogictips.com/what-is-a-codec/>

Baseband part in a mobile is comprised of a digital signal processor (DSP) to process forward voice/data signals for transmission and to process reverse voice/data signals received.

This is the core processing part which changes for various air interface standards like GSM, HSPA, LTE and more. It is often named as physical layer or Layer 1 or L1. For Speech/audio, codec is used to compress and decompress the signal to match the data rate to the frame it has to fit in. The baseband or physical layer will add redundant bits to enable error detection as well as error correction. Error detection is obtained with CRC and error correction with forward error correction techniques. Other than this interleaving is done for the data of one burst which helps in spreading the error over the time hence helps receiver de-interleave and decode the frame (consecutively data burst) correctly.

Source: <https://www.techplayon.com/mobile-phone-architecture/#:~:text=Baseband%20part%20in%20a%20mobile,%2C%20HSPA%2C%20LTE%20and%20more>



Source: <https://ss7.vzw.com/is/content/VerizonWireless/tcl-10-5g-uw-en-userguide-10212020>
 (Page 28)

63. The method practiced using the accused products further comprises the step of handling/controlling communication of said received and transmission data in accordance with a standardized network protocol and embedding and extracting said transmission and received data, respectively, in/from a data packet format according to said standardized network protocol, by protocol means.

64. For example, TCL 10 5G UW device supports Wi-Fi calling/Voice over Wi-Fi (VoWi-Fi). VoWi-Fi enables a user to make and receive calls over the internet.

65. As one example, when a calling party establishes a call using the VoWi-Fi feature, the voice input is converted into digital voice data and the digital voice data is split and encapsulated (“embedding”) into IP (Internet Protocol) packets (“data packet format”) by a device.

66. Further, when the digital voice data is received at the calling party's device, the digital voice data is processed and IP packets (encapsulated data) including the packetized voice data are extracted. The IP packets correspond to the IP protocol ("standardized network protocol"). The TCL 10 5G UW device includes a processor ("protocol means") for embedding and extracting the digital voice data into/from the IP packets, respectively.

TCL 10 5G UW - Turn Wi-Fi Calling On / Off

When turned on, Wi-Fi Calling may improve call quality while indoors.

Notes:

- For Wi-Fi Calling to work, verify:
 - Wi-Fi is turned on and connected.
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Source: <https://www.verizon.com/support/knowledge-base-235666/>

What is VoWiFi?

Voice over Wi-Fi (VoWiFi), as the name implies, is delivering voice service via WiFi network. Users can make calls without the need of mobile signal. VoWiFi is a complementary technology to Voice over LTE (VoLTE). Both make use of the IP Multimedia Subsystem (IMS) technology to realize the voice traffic as IP packets.

Source: <https://insinuator.net/2016/10/a-journey-into-the-depths-of-vowifi-security/>

Transport Layer (Layer 4)

Transport layer adds many information with original data as Transport layer header (Layer 4 header), which are relevant for data processing at the Transport layer.

The Application layer message is encapsulated at the Transport layer. If the protocol used at the Transport Layer is TCP (Transmission Control Protocol), the data packet is known as "TCP Segment". If the protocol used at the Transport layer is UDP (User Datagram Protocol), the data packet is known as "UDP Datagram".

Network Layer (Layer 3)

Network layer adds additional data as header, which are relevant for processing data at Network layer.

The data packet created at the Network layer by Internet Protocol (IPv4 or IPv6), which encapsulates its upper layer Transport layer segment/datagram, is known as "IP Datagram".

Source: <https://www.omniseccu.com/tcpip/tcpip-encapsulation-decapsulation.php>

Datalink Layer (Layer 2)

Receiver opens the Datalink layer header and trailer (Layer 2 header and trailer), uses the values at Datalink header and trailer for processing data at the Datalink layer.

Receiver then collects the Network layer packet (IPv4 or IPv6 Datagram), and it is transferred to Network layer for further processing.

Source: <https://www.omniseccu.com/tcpip/tcpip-encapsulation-decapsulation.php>

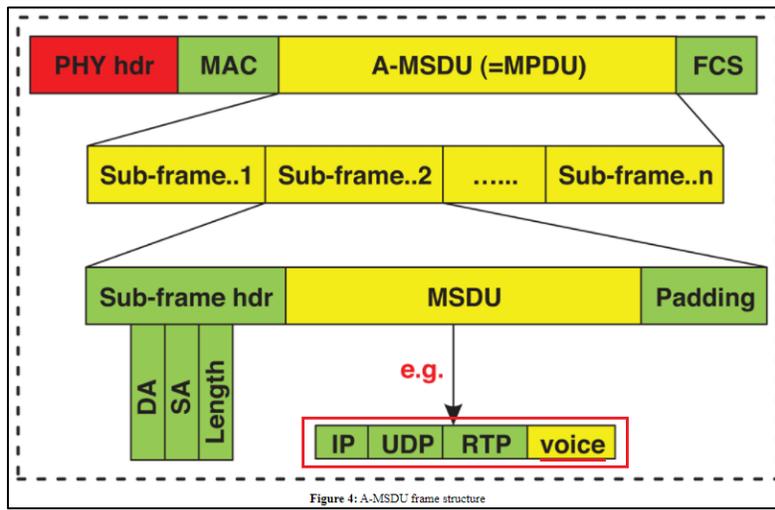


Figure 4: A-MSDU frame structure

Source: <https://www.techscience.com/cmc/v66n2/40658/html>

67. The method practiced using the accused products further comprises the step of receiving/sending, by wireless near field communication means, of said received data or said transmission data in said data packet format from/to said protocol means, embedding said transmission data in said data packet format received from said protocol means in a WiFi or

IEEE 802.11 format and extracting said received data in said data packet format from said WiFi or IEEE 802.11 format.

68. For example, a TCL 10 5G UW device supports Wi-Fi calling/Voice over Wi-Fi (VoWi-Fi). VoWi-Fi enables a user to make and receive calls over the Internet. As one example, when a calling party establishes a call using the VoWi-Fi feature, the voice input is processed and encapsulated into IP packets (“data packet format”) by the device. Further, when digital voice data is received at the calling party’s device, the data is processed and the encapsulated IP packets including the packetized voice data are extracted. The TCL 10 5G UW device includes a processor (“protocol means”) for embedding and extracting the digital data into/from IP packets, respectively.

69. The IP packets (“data packet format”) received from the protocol means are then embedded into PPDU (PLCP (Physical Layer Convergence Protocol) protocol Data Unit) frames (WiFi or IEEE 802.11 format) by adding appropriate headers such as Physical layer and MAC layer headers. The TCL 10 5G UW device includes a Wi-Fi chipset (“wireless near field communication means”) for embedding the IP packets into the IEEE 802.11 frame format (PPDUs).

70. When the calling party receives the voice data (i.e., PPDUs) from the wireless network, the embedded IP packets are extracted from these PPDU frames by the removal of the appropriate headers. The received PPDU frames (“WiFi or IEEE 802.11 format”) correspond to the IEEE 802.11 protocol. The extracted IP packets including the packetized voice data are then sent to the protocol means for further processing. The Wi-Fi chipset (“wireless near field communication means”) extracts the IP packets from the received PPDUs and sends them to the protocol means.

TCL 10 5G UW - Turn Wi-Fi Calling On / Off

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Voice over Wi-Fi (VoWiFi), as the name implies, is delivering voice service via WiFi network. Users can make calls without the need of mobile signal. VoWiFi is a complementary technology to Voice over LTE (VoLTE). Both make use of the IP Multimedia Subsystem (IMS) technology to realize the voice traffic as IP packets.

Source: <https://insinuator.net/2016/10/a-journey-into-the-depths-of-vowifi-security/>

Datalink layer (Layer 2)

The data packet generated at **Network layer** is then placed inside Datalink layer header and trailer (Layer 2 header and trailer). Values inside Datalink layer header and trailer are relevant for processing data at **Datalink layer**.

The data packet at the **Datalink layer**, which encapsulates and may subdivide the **IP Datagram**, is known as a "**Frame**" (generally **Ethernet Frame**).

The most important values at Datalink layer header (Layer 2 header) are source and destination MAC addresses (Layer 2 addresses). Following image represents data packet generated at **Datalink layer**.

Source: <https://www.omniseku.com/tcpip/tcpip-encapsulation-decapsulation.php>

Datalink Layer (Layer 2)

Receiver opens the Datalink layer header and trailer (Layer 2 header and trailer), uses the values at **Datalink header and trailer** for processing data at the **Datalink layer**.

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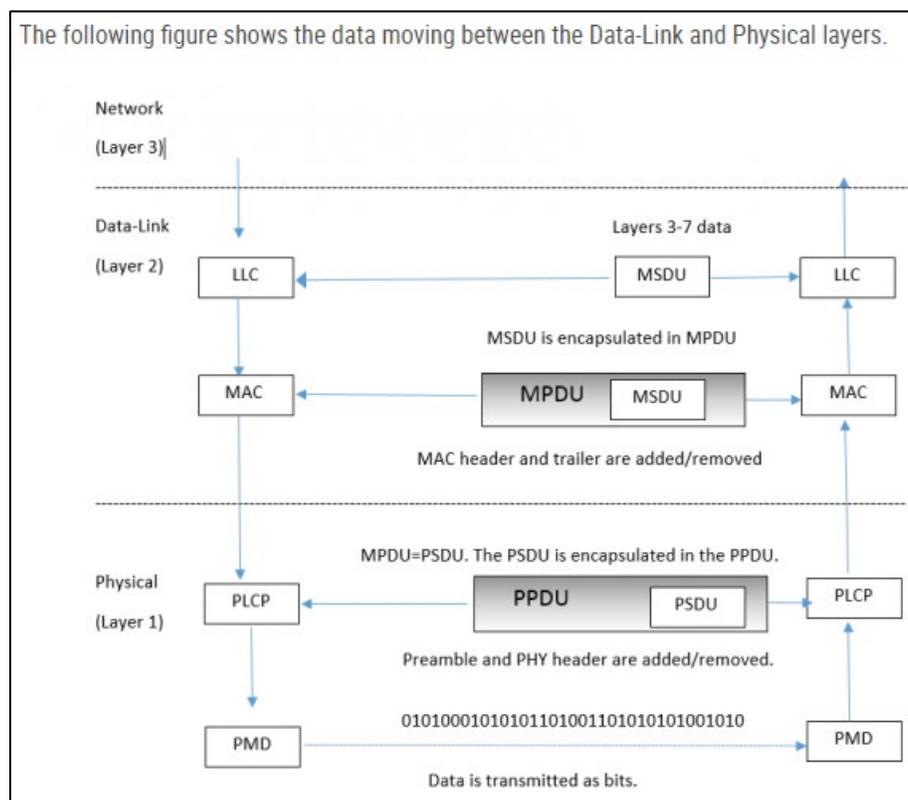
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physical layer (PHY) protocol data unit (PPDU): The unit of data exchanged between two peer PHY entities to provide the PHY data service.

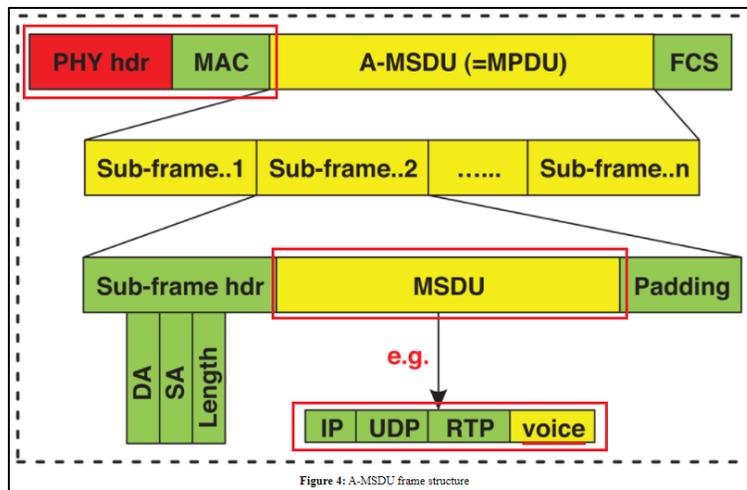
Source: <https://ieeexplore.ieee.org/document/7786995> (Page 138)

- When the Network layer (layer 3) sends data to the Data-Link layer, that data is handed off to the LLC and becomes known as the MAC Service Data Unit (MSDU).
- The payload of a 802.11 data frame is the layer 3-7 information known as the MSDU.
- A simple definition of the MSDU is that it is the data payload that contains the IP packet plus some LLC data.

Source: <https://dot11ap.wordpress.com/msdu-and-mpdu/>



Source: <https://www.cwnp.com/802.11-mac-series-ndash-basics-mac-architecture-ndash-part-1-3/>



Source: <https://www.techscience.com/cmc/v66n2/40658/html>

71. The method practiced using the accused products comprises the step of communicating, by said wireless near field communication means, said received data or said transmission data embedded in said WiFi or IEEE 802.11 format with a connecting unit communicating in said WiFi or IEEE 802.11 format to establish a connection to a network according to said standardized network protocol, whereby the resulting data exchanged between the wireless near field communication means and the connecting unit include packets in said data packet format embedded in said WiFi or 802.11 format.

72. For example, a TCL 10 5G UW device supports Wi-Fi calling/Voice over Wi-Fi (VoWi-Fi). VoWi-Fi enables a user to make and receive calls over the Internet. As one example, when a calling party establishes a call using the VoWi-Fi feature, the calling party's device embeds the digital voice data into IP packets. These IP packets ("data packet format") are then embedded into PPDUs frames ("WiFi or IEEE 802.11 format") by adding appropriate headers such as Physical layer and MAC layer headers. The TCL 10 5G UW device includes a Wi-Fi chipset ("wireless near field communication means") for embedding the IP packets into the IEEE 802.11 frame format (PPDUs).

73. The Wi-Fi chipset (“wireless near field communication means”) of the device transmits the PPDU’s (“transmission data embedded in said WiFi or IEEE 802.11 format”) to 802.11 router/access point (“connecting unit”) using corresponding wireless communication antennas. The Wi-Fi chipset of the device also receives PPDU’s (“received data”) from the 802.11 router/access point (“connecting unit”) using corresponding wireless communication antennas. These PPDU’s correspond to the IEEE 802.11 frame format (“WiFi or IEEE 802.11 format”) and include the embedded IP (“data packet format”) packets with packetized voice data.

74. Further, the 802.11 access points are connected to the internet according to the Internet Protocol (“standardized network protocol”).

TCL 10 5G UW - Turn Wi-Fi Calling On / Off

When turned on, Wi-Fi Calling may improve call quality while indoors.

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Receiver then collects the Network layer packet (IPv4 or IPv6 Datagram), and it is transferred to **Network layer** for further processing.

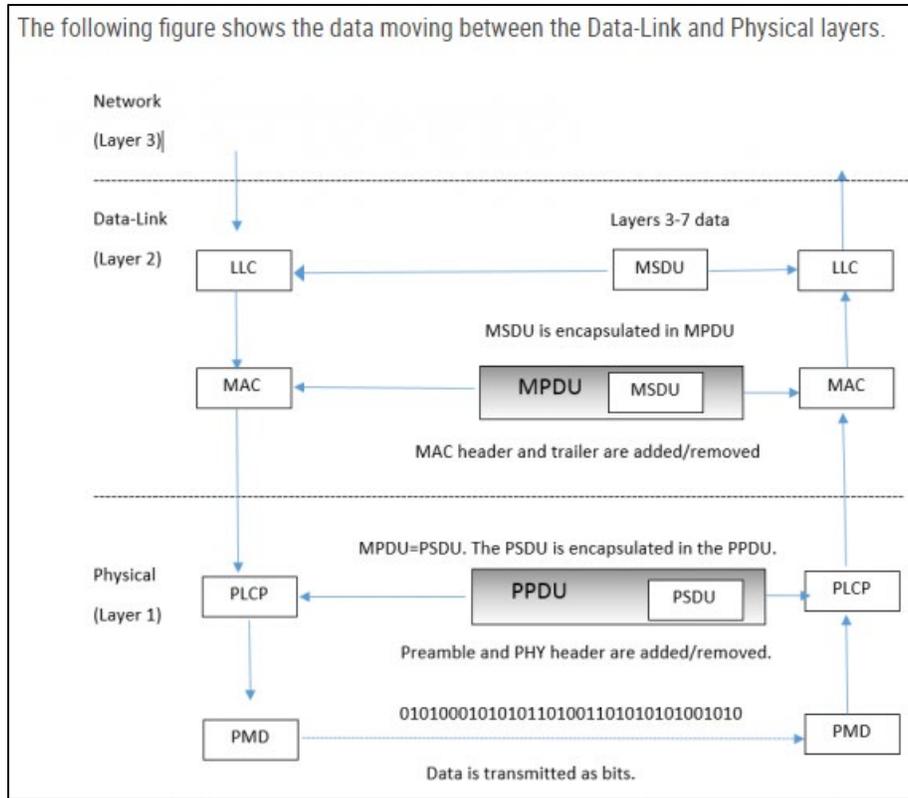
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physical layer (PHY) protocol data unit (PPDU): The unit of data exchanged between two peer PHY entities to provide the PHY data service.

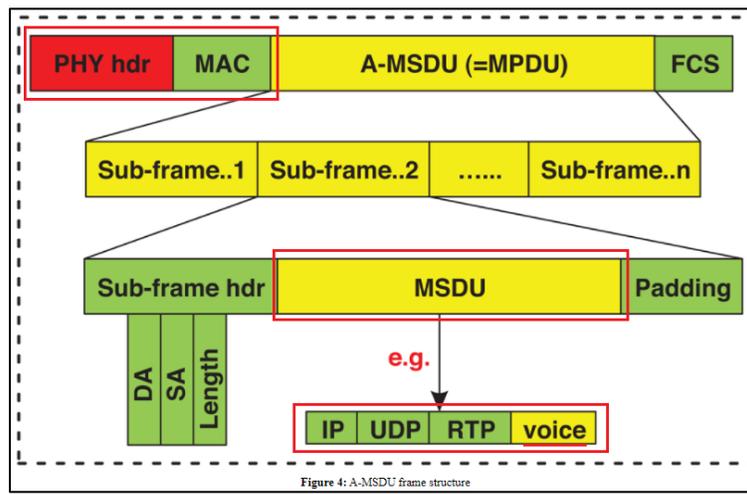
Source: <https://ieeexplore.ieee.org/document/7786995> (Page 138)

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- A simple definition of the MSDU is that it is the data payload that contains the IP packet plus some LLC data.

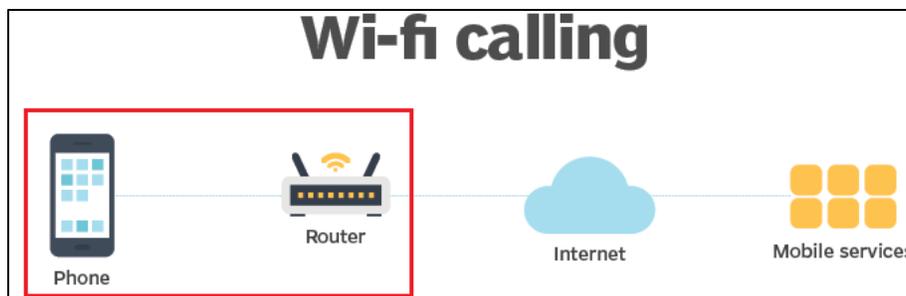
Source: <https://dot11ap.wordpress.com/msdu-and-mpdu/>



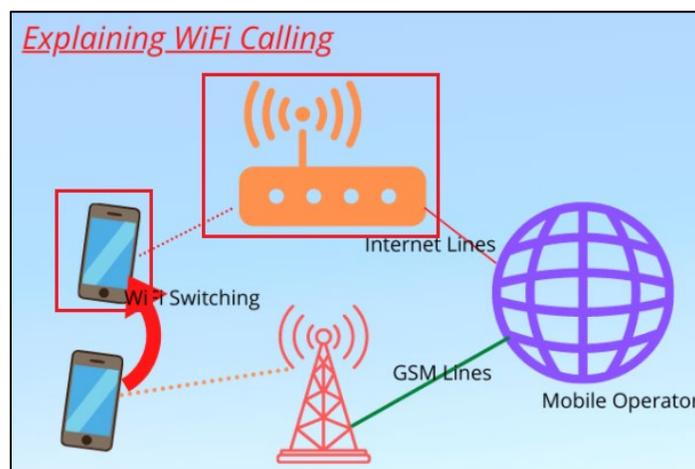
Source: <https://www.cwnp.com/802.11-mac-series-ndash-basics-mac-architecture-ndash-part-1-3/>



Source: <https://www.techscience.com/cmc/v66n2/40658/html>



Source: <https://whatis.techtarget.com/definition/Wi-Fi-calling>



Source: <https://www.cspprotocol.com/what-is-wifi-calling/>

75. Buffalo Patents has been damaged as a result of the infringing conduct by TCL alleged above. Thus, TCL is liable to Buffalo Patents in an amount that adequately compensates it for such infringements, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

76. Buffalo Patents is only asserting method claims for the '915 Patent, and therefore, 35 U.S.C § 287(a) does not apply.

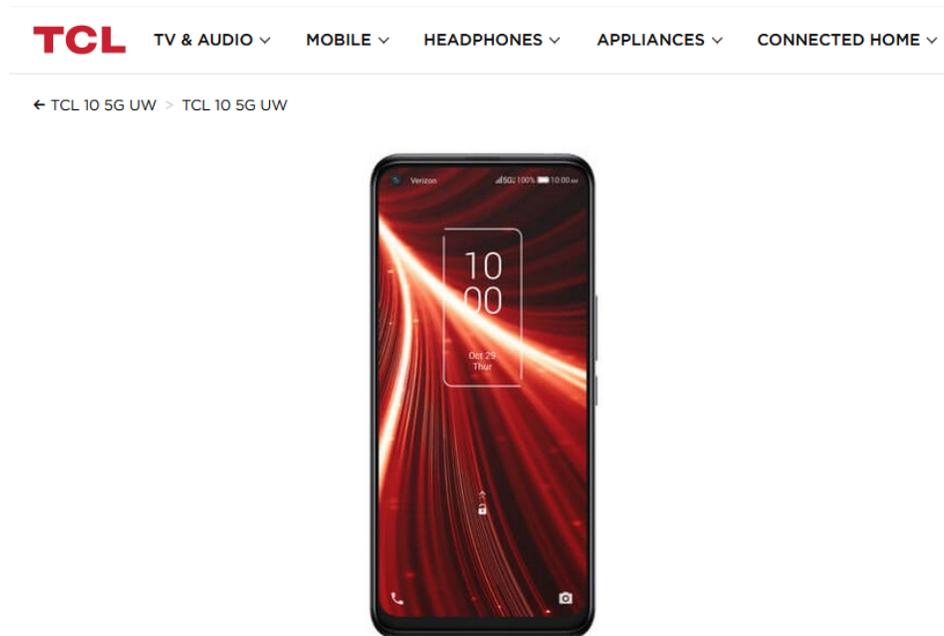
COUNT III

DIRECT INFRINGEMENT OF U.S. PATENT NO. 8,611,328

77. On December 17, 2013, United States Patent No. 8,611,328 (“the ’328 Patent”) was duly and legally issued by the United States Patent and Trademark Office for an invention entitled “Communications Terminal, a System and a Method for Internet/Network Telephony.”

78. Buffalo Patents is the owner of the ’328 Patent, with all substantive rights in and to that patent, including the sole and exclusive right to prosecute this action and enforce the ’328 Patent against infringers, and to collect damages for all relevant times.

79. TCL made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its TCL 10 5G UW Smartphone and other products that support Voice over Wi-Fi (VoWi-Fi) or Wi-Fi calling (“accused products”):



Source: <https://www.tcl.com/us/en/products/mobile/tcl-10-5g-uw/t790s>

80. By doing so, TCL has directly infringed (literally and/or under the doctrine of equivalents) at least Claim 8 of the '328 Patent. TCL's infringement in this regard is ongoing.

81. The TCL 10 5G UW Smartphone is an exemplary accused product.

82. TCL has infringed the '328 Patent by using the accused products and thereby practicing a method comprising converting a first signal representing a detected sound to first digital data.

83. For example, TCL 10 5G UW device supports Wi-Fi calling/Voice over Wi-Fi (VoWi-Fi). VoWi-Fi enables a user to make and receive calls over the internet. A TCL 10 5G UW device includes a codec (coder/decoder) to convert the analog voice input to digital data. As one example, when a user establishes a call using the VoWi-Fi feature, the sound waves generated by the user are converted into analog electrical signals ("first signal") by a microphone. The electrical signals contain the voice data which is compressed and converted into digital data ("first digital data") with the help of a codec.

MODEL T790S

TCL 10 5G UW - T790S

Suggested Price
\$399.99

WHERE TO BUY

- 6.53" FHD+ display with dedicated display engine for enhanced visuals.
- Qualcomm® Snapdragon™ 765, Octa-core processor, and 6GB of RAM for smooth performance.
- 5G connectivity for super-fast gaming, streaming, and video calling.
- Up to 128GB of internal memory, expandable up to an additional 256GB via optional microSD™ card.
- Triple rear cameras with dual LED flash: 48MP (main) + 8MP (super wide-angle) + 5MP (macro)
- 16MP front-facing camera with 4-in-1 big pixel technology for brighter selfies.
- Fast-charging 4500 mAh battery with OTG reverse charging capability.
- Fingerprint sensor and face unlock for fast and secure access.

DIAMOND GRAY
\$399.99

Source: <https://www.tcl.com/us/en/products/mobile/tcl-10-5g-uw/t790s>

TCL 10 5G UW - Turn Wi-Fi Calling On / Off

When turned on, Wi-Fi Calling may improve call quality while indoors.

Notes:

- For Wi-Fi Calling to work, verify:
 - Wi-Fi is turned on and connected.
 - HD Voice is activated first while in the Verizon wireless coverage area (can't be activated internationally).

Source: <https://www.verizon.com/support/knowledge-base-235666/>

What is Voice over Wi-Fi?

Voice over Wi-Fi (VoWi-Fi) refers to the use of IEEE 802.11 wireless LANs (WLANs) to transport Voice over IP (VoIP) traffic. The technology has consumer, business and service provider applications. It is used over private WLANs, home Wi-Fi networks and public Wi-Fi hotspots.

Source: <https://ribboncommunications.com/company/get-help/glossary/voice-over-wi-fi>

Microphone

The microphone changes the sound waves from your voice into electrical signals that are sent to the audio amplifier of the radio components. A microphone is essentially a speaker that works in reverse. When sound waves from your voice move the membrane, they make tiny electric currents either by moving a coil of wire within a magnet or by compressing the membrane against carbon dust (see [How do microphones work?](#) for details).

Source: <https://electronics.howstuffworks.com/cordless-telephone4.htm>



Source: <https://ss7.vzw.com/is/content/VerizonWireless/tcl-10-5g-uw-en-userguide-10212020>

(Page 28)

3. Codecs

The quality of voice is a characteristic on digital telephony. Since VoIP and VoWiFi combine digital telephony and networking technologies they also have the quality of voice characteristic. An important element that controls the quality of voice is the compression, and conversion of analog to digital (codec) used on the voice traffic. There are numerous codecs defined for use with voice traffic. The following sections will introduce and give an overview of a few current codecs in use.

Source: https://www.cse.wustl.edu/~jain/cse574-06/ftp/wireless_voip/index.html

Baseband part in a mobile is comprised of a digital signal processor (DSP) to process forward voice/data signals for transmission and to process reverse voice/data signals received.

This is the core processing part which changes for various air interface standards like GSM, HSPA, LTE and more. It is often named as physical layer or Layer 1 or L1. For Speech/audio, codec is used to compress and decompress the signal to match the data rate to the frame it has to fit in. The baseband or physical layer will add redundant bits to enable error detection as well as error correction. Error detection is obtained with CRC and error correction with forward error correction techniques. Other than this interleaving is done for the data of one burst which helps in spreading the error over the time hence helps receiver de-interleave and decode the frame (consecutively data burst) correctly.

Source: <https://www.techplayon.com/mobile-phone-architecture/#:~:text=Baseband%20part%20in%20a%20mobile,%2C%20HSPA%2C%20LTE%20and%20more>

84. The method practiced using the accused products further comprises converting the first digital data into one or more first data packets that accord to a network protocol of a first network.

85. For example, a TCL 10 5G UW device supports Wi-Fi calling/Voice over Wi-Fi (VoWi-Fi). VoWi-Fi enables a user to make and receive calls over the internet. As one example, when a user establishes a call using the VoWi-Fi feature, the voice data from the caller is compressed and converted into digital data. The digital data (“first digital data”) is encapsulated into IP packets (“first data packets”). These IP packets correspond to the Internet protocol (“network protocol of a first network”).

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Source: <https://www.verizon.com/support/knowledge-base-235666/>

What is Voice over Wi-Fi?

Voice over Wi-Fi (VoWi-Fi) refers to the use of IEEE 802.11 wireless LANs (WLANs) to transport Voice over IP (VoIP) traffic. The technology has consumer, business and service provider applications. It is used over private WLANs, home Wi-Fi networks and public Wi-Fi hotspots.

Source: <https://ribboncommunications.com/company/get-help/glossary/voice-over-wi-fi>

What is VoWiFi?

Voice over Wi-Fi (VoWiFi), as the name implies, is delivering voice service via WiFi network. Users can make calls without the need of mobile signal. VoWiFi is a complementary technology to Voice over LTE (VoLTE). Both make use of the IP Multimedia Subsystem (IMS) technology to realize the voice traffic as IP packets.

Source: <https://insinuator.net/2016/10/a-journey-into-the-depths-of-vowifi-security/>

Transport Layer (Layer 4)

Transport layer adds many information with original data as Transport layer header (Layer 4 header), which are relevant for data processing at the Transport layer.

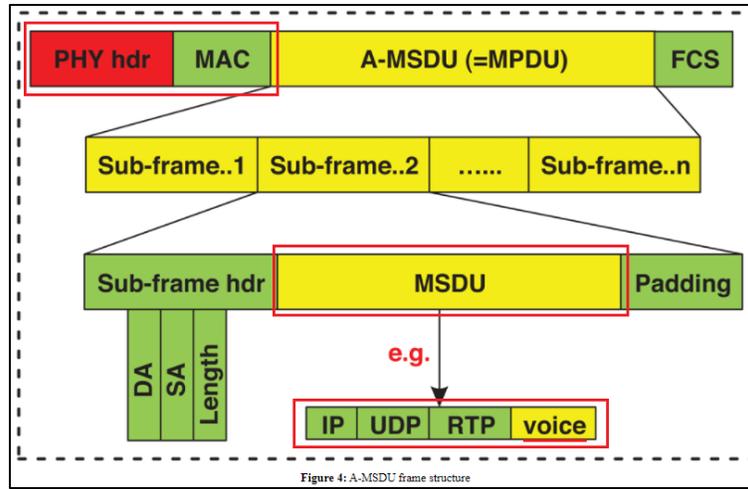
The Application layer message is encapsulated at the Transport layer. If the protocol used at the Transport Layer is TCP (Transmission Control Protocol), the data packet is known as "TCP Segment". If the protocol used at the Transport layer is UDP (User Datagram Protocol), the data packet is known as "UDP Datagram".

Network Layer (Layer 3)

Network layer adds additional data as header, which are relevant for processing data at Network layer.

The data packet created at the Network layer by Internet Protocol (IPv4 or IPv6), which encapsulates its upper layer Transport layer segment/datagram, is known as "IP Datagram".

Source: <https://www.omniseccu.com/tcpip/tcpip-encapsulation-decapsulation.php>



Source: <https://www.techscience.com/cmc/v66n2/40658/html>

86. The method practiced using the accused products further comprises embedding one or more first data packets into first wireless data that accords to a network protocol of a near field communication network.

87. For example, a TCL 10 5G UW device supports Wi-Fi calling/Voice over Wi-Fi (VoWi-Fi). VoWi-Fi enables a user to make and receive calls over the internet. As one example, when a user establishes a call using the VoWi-Fi feature, the voice data is compressed and encapsulated into IP packets. The IP packets (“first data packets”) are embedded into PPDU (PLCP (Physical Layer Convergence Protocol) protocol Data Unit) frames by adding appropriate headers such as Physical layer and MAC layer headers. The PPDUs (“first wireless data”) are formatted according to the 802.11 protocol (“network protocol of a near field communication network”) frame format.

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Source: <https://www.verizon.com/support/knowledge-base-235666/>

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Source: <https://insinuator.net/2016/10/a-journey-into-the-depths-of-vowifi-security/>

Datalink layer (Layer 2)

The data packet generated at **Network layer** is then placed inside Datalink layer header and trailer (Layer 2 header and trailer). Values inside Datalink layer header and trailer are relevant for processing data at **Datalink layer**.

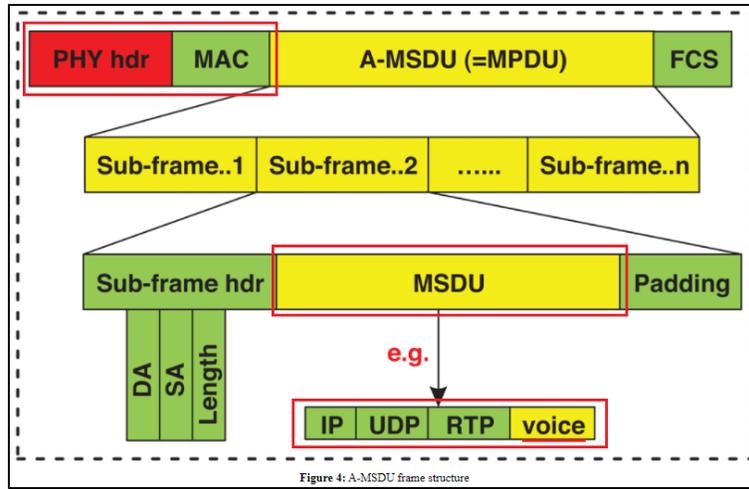
The data packet at the **Datalink layer**, which encapsulates and may subdivide the **IP Datagram**, is known as a "**Frame**" (generally **Ethernet Frame**).

The most important values at Datalink layer header (Layer 2 header) are source and destination MAC addresses (Layer 2 addresses). Following image represents data packet generated at **Datalink layer**.

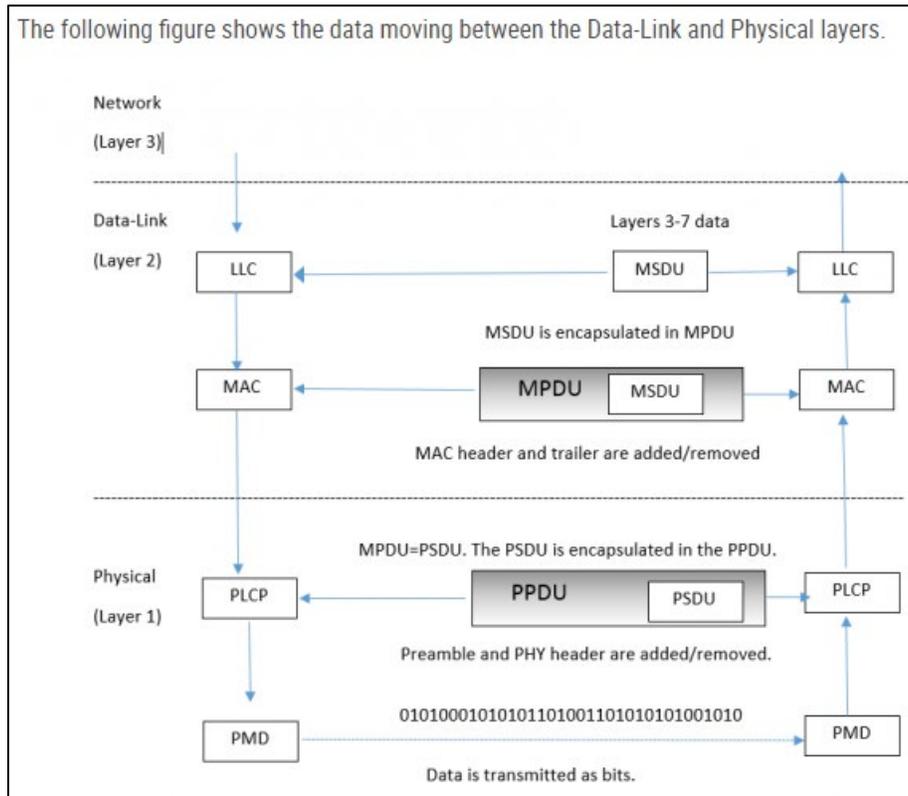
Source: <https://www.omnisecu.com/tcpip/tcpip-encapsulation-decapsulation.php>

physical layer (PHY) protocol data unit (PPDU): The unit of data exchanged between two peer PHY entities to provide the PHY data service.

Source: <https://ieeexplore.ieee.org/document/7786995> (Page 138)



Source: <https://www.techscience.com/cmc/v66n2/40658/html>



Source: <https://www.cwnp.com/802.11-mac-series-ndash-basics-mac-architecture-ndash-part-1-3/>

- When the Network layer (layer 3) sends data to the Data-Link layer, that data is handed off to the LLC and becomes known as the MAC Service Data Unit (MSDU).
- The payload of a 802.11 data frame is the layer 3-7 information known as the MSDU.
- A simple definition of the MSDU is that it is the data payload that contains the IP packet plus some LLC data.

Source: <https://dot11ap.wordpress.com/msdu-and-mpdu/>

88. The method practiced using the accused products further comprises transmitting the first wireless data via the near field communication network in accordance with the network protocol of the second network.

89. For example, a TCL 10 5G UW device supports Wi-Fi calling/Voice over Wi-Fi (VoWi-Fi). VoWi-Fi enables a user to make and receive calls over the internet using Wi-Fi access points. VoWi-Fi allows the delivery of voice traffic as IP packets via a Wi-Fi network.

90. As one example, when a user establishes a call using the VoWi-Fi feature, the voice data is compressed and encapsulated into IP packets and further embedded into PPDU frames. The PPDU data corresponds to the 802.11 protocol (“network protocol of the second network”). The PPDU frames are then transmitted using Wi-Fi access points (“near field communication network”).

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Source: <https://www.verizon.com/support/knowledge-base-235666/>

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Source: <https://ribboncommunications.com/company/get-help/glossary/voice-over-wi-fi>

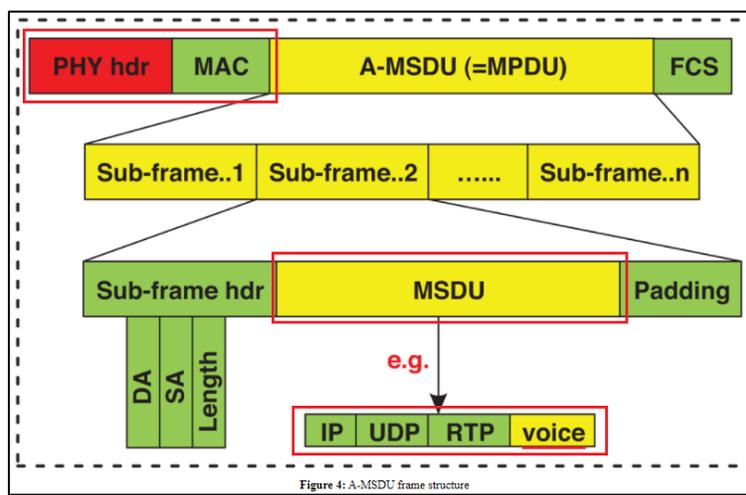
What is VoWiFi?

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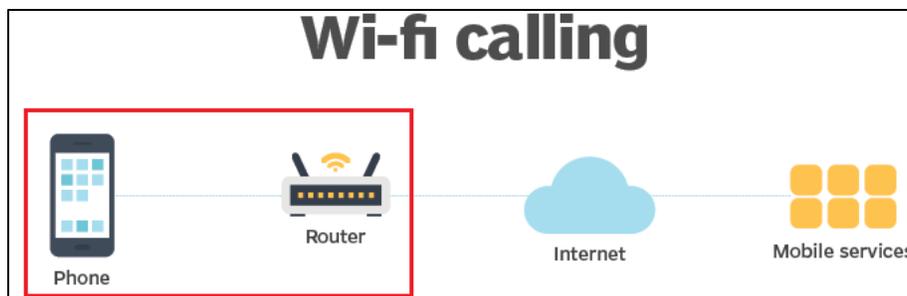
Source: <https://insinuator.net/2016/10/a-journey-into-the-depths-of-vowifi-security/>

physical layer (PHY) protocol data unit (PPDU): The unit of data exchanged between two peer PHY entities to provide the PHY data service.

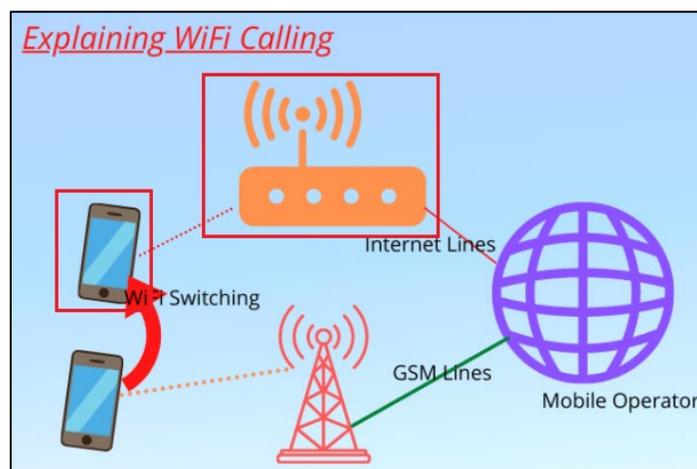
Source: <https://ieeexplore.ieee.org/document/7786995> (Page 138)



Source: <https://www.techscience.com/cmc/v66n2/40658/html>



Source: <https://whatis.techtarget.com/definition/Wi-Fi-calling>



Source: <https://www.cspprotocol.com/what-is-wifi-calling/>

91. Buffalo Patents has been damaged as a result of the infringing conduct by TCL alleged above. Thus, TCL is liable to Buffalo Patents in an amount that adequately compensates it for such infringements, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

92. Buffalo Patents is only asserting method claims for the '328 Patent, and therefore, 35 U.S.C § 287(a) does not apply.

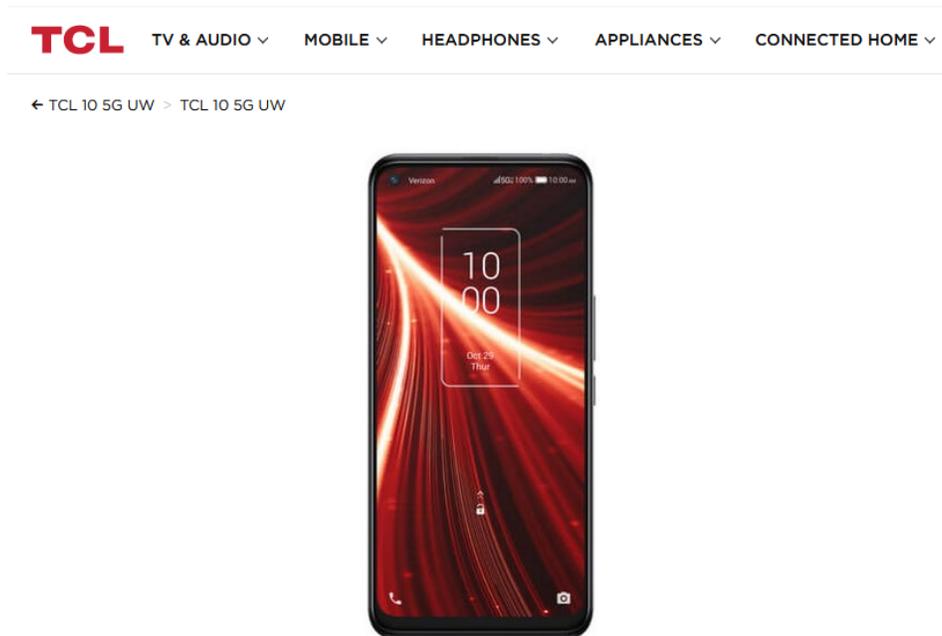
COUNT IV

DIRECT INFRINGEMENT OF U.S. PATENT NO. 9,001,816

93. On April 7, 2015, United States Patent No. 9,001,816 (“the ’816 Patent”) was duly and legally issued by the United States Patent and Trademark Office for an invention entitled “Communications Terminal, a System and a Method for Internet/Network Telephony.”

94. Buffalo Patents is the owner of the ’816 Patent, with all substantive rights in and to that patent, including the sole and exclusive right to prosecute this action and enforce the ’816 Patent against infringers, and to collect damages for all relevant times.

95. TCL made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its TCL 10 5G UW Smartphone and other products that support Voice over Wi-Fi (VoWi-Fi) or Wi-Fi calling (“accused products”):



Source: <https://www.tcl.com/us/en/products/mobile/tcl-10-5g-uw/t790s>

96. By doing so, TCL has directly infringed (literally and/or under the doctrine of equivalents) at least Claim 10 of the '816 Patent. TCL's infringement in this regard is ongoing.

97. The TCL 10 5G UW Smartphone is an exemplary accused product.

98. TCL has infringed the '816 Patent by using the accused products and thereby practicing a method comprising receiving, via a near field network, wireless data that accords to a first network protocol, wherein the wireless data includes a data packet that accords to a second network protocol.

99. For example, a TCL 10 5G UW device supports Wi-Fi calling/Voice over Wi-Fi (VoWi-Fi). VoWi-Fi enables a user to make and receive calls over the internet using Wi-Fi access points. VoWi-Fi allows the delivery of voice traffic as IP packets via a Wi-Fi network.

100. As one example, when a user (caller) establishes a call using the VoWi-Fi feature with another user (receiver), the voice data from the caller is compressed and encapsulated into IP packets, and then formatted according to the IEEE 802.11 protocol frame format for transmission using 802.11 WLAN (Wireless Local Area Network) access points. The formatted data is transmitted in the form of PPDU (Physical Layer Convergence Protocol) protocol Data Unit). The receiver receives the transmitted PPDU via a Wi-Fi network ("near field network"). The PPDU ("wireless data") received by the receiver correspond to the 802.11 protocol ("first network protocol") and the IP packets ("data packet") embedded in the received PPDU correspond to the Internet protocol ("second network protocol").

MODEL T790S

TCL 10 5G UW - T790S

Suggested Price
\$399.99

WHERE TO BUY

- 6.53" FHD+ display with dedicated display engine for enhanced visuals.
- Qualcomm® Snapdragon™ 765, Octa-core processor, and 6GB of RAM for smooth performance.
- 5G connectivity for super-fast gaming, streaming, and video calling.
- Up to 128GB of internal memory, expandable up to an additional 256GB via optional microSD™ card.
- Triple rear cameras with dual LED flash: 48MP (main) + 8MP (super wide-angle) + 5MP (macro)
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- Fingerprint sensor and face unlock for fast and secure access.

DIAMOND GRAY
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Source: <https://www.tcl.com/us/en/products/mobile/tcl-10-5g-uw/t790s>

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Source: <https://ribboncommunications.com/company/get-help/glossary/voice-over-wi-fi>

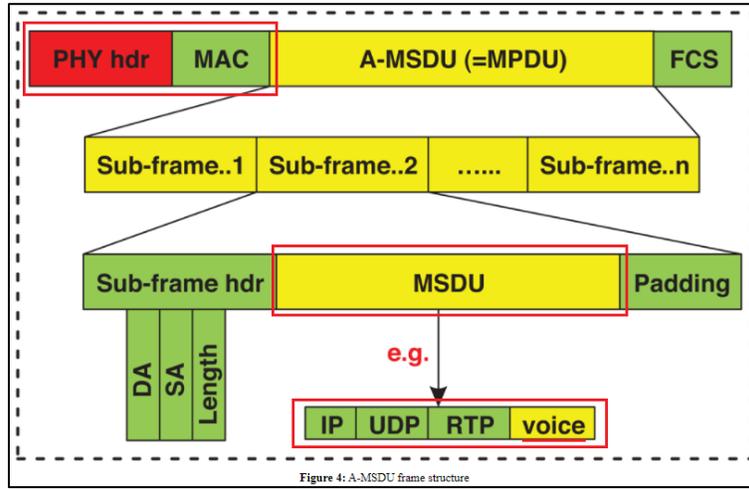
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Source: <https://insinuator.net/2016/10/a-journey-into-the-depths-of-vowifi-security/>

physical layer (PHY) protocol data unit (PPDU): The unit of data exchanged between two peer PHY entities to provide the PHY data service.

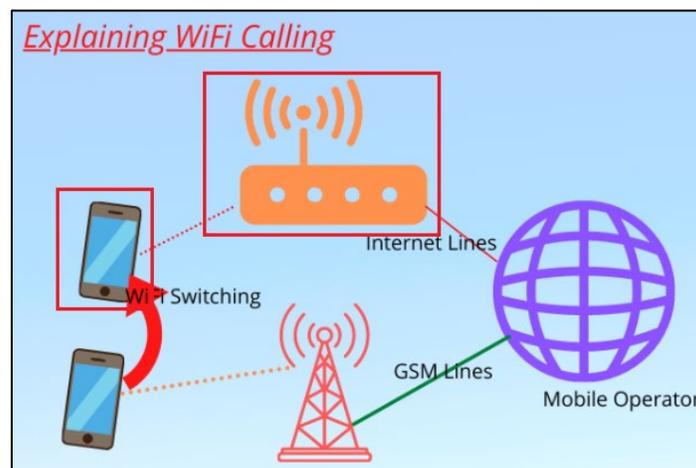
Source: <https://ieeexplore.ieee.org/document/7786995> (Page 138)



Source: <https://www.techscience.com/cmc/v66n2/40658/html>



Source: <https://whatis.techtarget.com/definition/Wi-Fi-calling>



Source: <https://www.cspprotocol.com/what-is-wifi-calling/>

101. The method practiced using the accused products further comprises extracting the data packet from the wireless data.

102. For example, a TCL 10 5G UW device supports Wi-Fi calling/Voice over Wi-Fi (VoWi-Fi). As one example, when a user (caller) establishes a call using the VoWi-Fi feature with another user (the receiver), the receiver receives transmitted PPDU's from a caller via a Wi-Fi network. The received PPDU's include appropriate headers such as Physical layer and MAC layer headers. The headers are removed from the received PPDU's ("wireless data") in order to extract an IP packet ("data packet"), which includes the packetized voice data.

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Source: <https://insinuator.net/2016/10/a-journey-into-the-depths-of-vowifi-security/>

Datalink Layer (Layer 2)

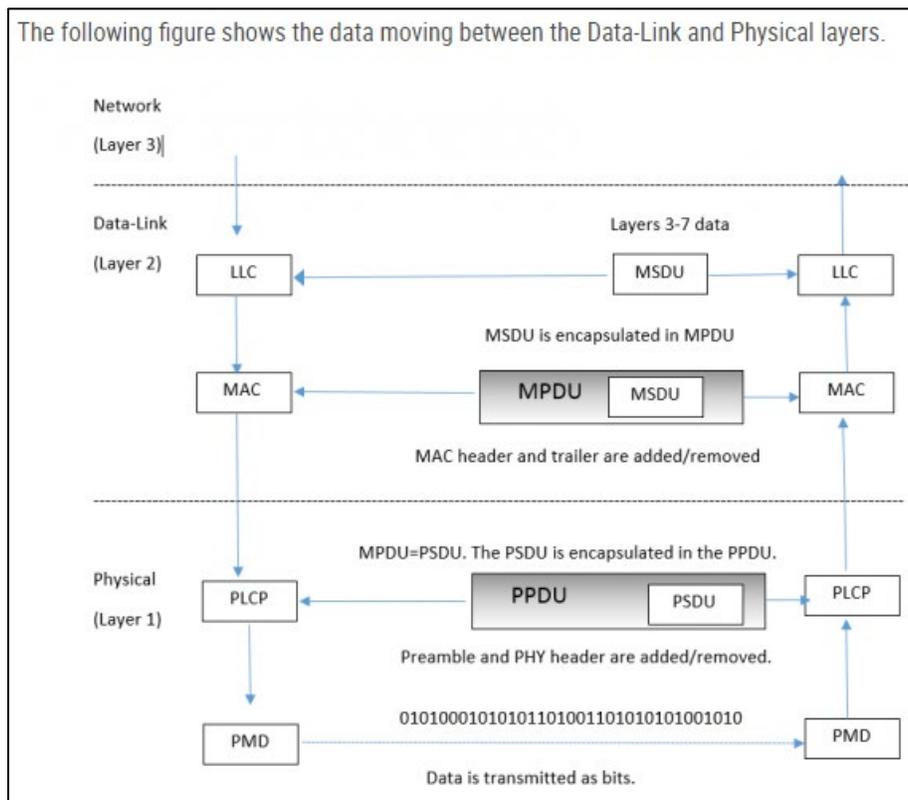
Receiver opens the Datalink layer header and trailer (Layer 2 header and trailer), uses the values at Datalink header and trailer for processing data at the Datalink layer.

Receiver then collects the Network layer packet (IPv4 or IPv6 Datagram), and it is transferred to Network layer for further processing.

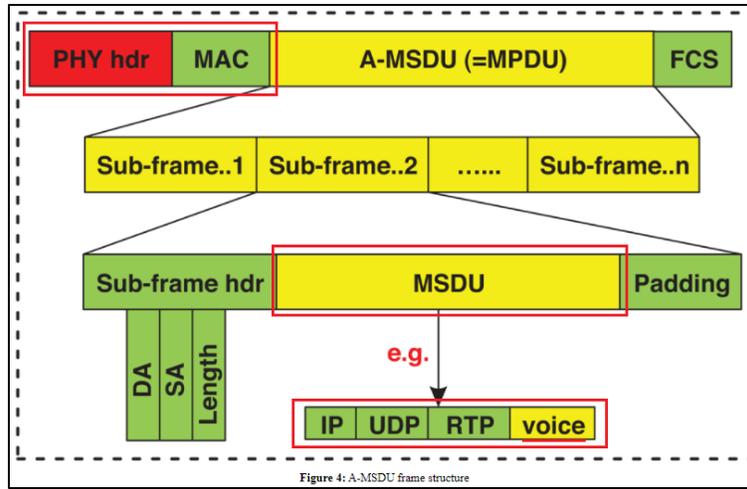
Source: <https://www.omniseccu.com/tcpip/tcpip-encapsulation-decapsulation.php>

- When the Network layer (layer 3) sends data to the Data-Link layer, that data is handed off to the LLC and becomes known as the MAC Service Data Unit (MSDU).
- The payload of a 802.11 data frame is the layer 3-7 information known as the MSDU.
- A simple definition of the MSDU is that it is the data payload that contains the IP packet plus some LLC data.

Source: <https://dot11ap.wordpress.com/msdu-and-mpdu/>



Source: <https://www.cwnp.com/802.11-mac-series-ndash-basics-mac-architecture-ndash-part-1-3/>



Source: <https://www.techscience.com/cmc/v66n2/40658/html>

103. The method practiced using the accused products further comprises generating a sound based on the data packet.

104. For example, a TCL 10 5G UW device supports Wi-Fi calling/Voice over Wi-Fi (VoWi-Fi). As one example, when a user (caller) establishes a call using the VoWi-Fi feature with another user (the receiver), the receiver receives transmitted PPDU's from a caller via a Wi-Fi network. The PPDU's are then decapsulated to extract an IP packet ("data packet") which includes the packetized voice data from the caller. The extracted IP packet is processed to convert the digital voice data into an analog voice signal using a codec. The analog voice signal is then fed to a speaker of the receiver's device for generating sound corresponding to the voice data extracted from the IP packet.

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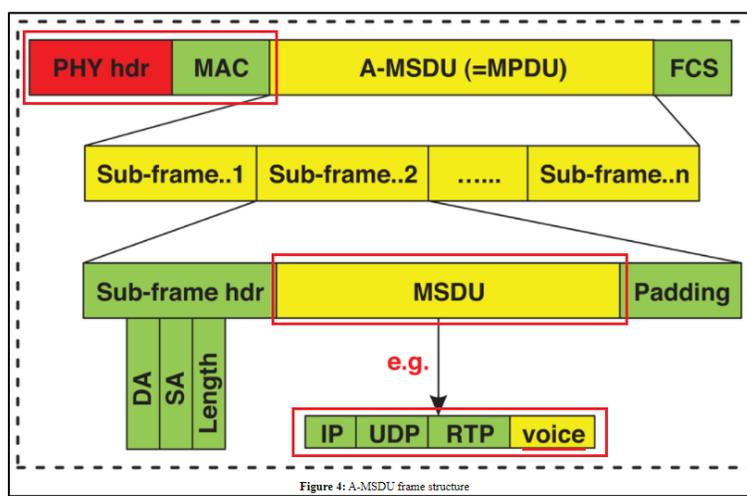
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Source: <https://www.verizon.com/support/knowledge-base-235666/>

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Source: <https://www.techscience.com/cmc/v66n2/40658/html>

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Source: <https://www.techplayon.com/mobile-phone-architecture/#:~:text=Baseband%20part%20in%20a%20mobile,%2C%20HSPA%2C%20LTE%20and%20more>

One common application for CODECs is with Digital Signal Processors (DSPs) in audio electronics devices. CODECs convert sound (using the ADC) to digital signals for a processor to compress and store and for playback, the stored digital data is decompressed and converted to analog signals via the DAC. The analog signal reaches the human ear by converting the analog signal into a transmissible sound via a pulse width modulator and a speaker, for example.

Source: <https://www.analogictips.com/what-is-a-codec/>



Source: <https://ss7.vzw.com/is/content/VerizonWireless/tcl-10-5g-uw-en-userguide-10212020>
(Page 28)

105. Buffalo Patents has been damaged as a result of the infringing conduct by TCL alleged above. Thus, TCL is liable to Buffalo Patents in an amount that adequately compensates it for such infringements, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

106. Buffalo Patents is only asserting method claims for the '328 Patent, and therefore, 35 U.S.C § 287(a) does not apply.

**ADDITIONAL ALLEGATIONS REGARDING INFRINGEMENT
AND PERSONAL JURISDICTION**

107. TCL has also indirectly infringed the '670 Patent by inducing others to directly infringe the '670 Patent.

108. TCL has induced the end users and/or TCL's customers to directly infringe (literally and/or under the doctrine of equivalents) the '670 Patent by using the accused products.

109. TCL took active steps, directly and/or through contractual relationships with others, with the specific intent to cause them to use the accused products in a manner that infringes one or more claims of the '670 Patent, including, for example, Claim 1 of the '670 Patent.

110. Such steps by TCL included, among other things, advising or directing customers, end users, and others (including third party testing and certification organizations) to use the accused products in an infringing manner; advertising and promoting the use of the accused products in an infringing manner; and/or distributing instructions that guide users to use the accused products in an infringing manner.

111. TCL performed these steps, which constitute joint and/or induced infringement, with the knowledge of the '670 Patent and with the knowledge that the induced acts constitute infringement.

112. TCL was and is aware that the normal and customary use of the accused products by TCL's customers would infringe the '670 Patent. TCL's inducement is ongoing.

113. TCL has also induced its affiliates, or third-party manufacturers, shippers, distributors, retailers, or other persons acting on its or its affiliates' behalf, to directly infringe (literally and/or under the doctrine of equivalents) the '670 Patent by importing, selling or offering to sell the accused products.

114. TCL has a significant role in placing the accused products in the stream of commerce with the expectation and knowledge that they will be purchased by consumers in Texas and elsewhere in the United States.

115. TCL purposefully directs or controls the making of accused products and their shipment to the United States, using established distribution channels, for sale in Texas and elsewhere within the United States.

116. TCL purposefully directs or controls the sale of the accused products into established United States distribution channels, including sales to nationwide retailers. TCL's established United States distribution channels include one or more United States based affiliates (e.g., TCL North America).

117. TCL purposefully directs or controls the sale of the accused products online and in nationwide retailers such as Amazon and Best Buy, including for sale in Texas and elsewhere in the United States, and expects and intends that the accused products will be so sold.

118. TCL purposefully places the accused products—whether by itself or through subsidiaries, affiliates, or third parties—into an international supply chain, knowing that the accused products will be sold in the United States, including Texas. Therefore, TCL also facilitates the sale of the accused products in Texas.

119. TCL took active steps, directly and/or through contractual relationships with others, with the specific intent to cause such persons to import, sell, or offer to sell the accused products in a manner that infringes one or more claims of the '670 Patent.

120. Such steps by TCL included, among other things, making or selling the accused products outside of the United States for importation into or sale in the United States, or knowing that such importation or sale would occur; and directing, facilitating, or influencing its affiliates, or third-party manufacturers, shippers, distributors, retailers, or other persons acting on its or its affiliates' behalf, to import, sell, or offer to sell the accused products in an infringing manner.

121. TCL performed these steps, which constitute induced infringement, with the knowledge of the '670 Patent, and with the knowledge that the induced acts would constitute infringement.

122. TCL performed such steps in order to profit from the eventual sale of the accused products in the United States.

123. TCL's inducement is ongoing.

124. TCL has also indirectly infringed by contributing to the infringement of the '670 Patent. TCL has contributed to the direct infringement of the '670 Patent by the end user of the accused products.

125. The accused products have special features that are specially designed to be used in an infringing way and that have no substantial uses other than ones that infringe the '670 Patent, including, for example, Claim 1 of the '670 Patent.

126. The special features include, for example, improved wireless communication capabilities used in a manner that infringes the '670 Patent.

127. These special features constitute a material part of the invention of one or more of the claims of the '670 Patent, and are not staple articles of commerce suitable for substantial non-infringing use.

128. TCL's contributory infringement is ongoing.

129. TCL has had actual knowledge of the '670 Patent at least as of the date when it was notified of the filing of this action. Since at least that time, TCL has known the scope of the claims of the '670 Patent, the products that practice the '670 Patent, and that Buffalo Patents is the owner of the '670 Patent.

130. By the time of trial, TCL will have known and intended (since receiving such notice) that its continued actions would infringe and actively induce and contribute to the infringement of one or more claims of the '670 Patent.

131. Furthermore, TCL has a policy or practice of not reviewing the patents of others (including instructing its employees to not review the patents of others), and thus has been willfully blind of Buffalo Patents' patent rights. *See, e.g.*, M. Lemley, "Ignoring Patents," 2008 Mich. St. L. Rev. 19 (2008).

132. TCL's actions are at least objectively reckless as to the risk of infringing valid patents, and this objective risk was either known or should have been known by TCL. TCL has knowledge of the '670 Patent.

133. TCL's customers have infringed the '670 Patent. TCL encouraged its customers' infringement.

134. TCL's direct and indirect infringement of the '670 Patent, and its direct infringement of the '915 Patent, the '328 Patent, and the '816 Patent has been, and/or continues to be willful, intentional, deliberate, and/or in conscious disregard of Buffalo Patents' rights under the patents-in-suit.

135. Buffalo Patents has been damaged as a result of TCL's infringing conduct alleged above. Thus, TCL is liable to Buffalo Patents in an amount that adequately compensates it for such infringements, which, by law, cannot be less than a reasonable royalty, together with interest and costs as fixed by this Court under 35 U.S.C. § 284.

JURY DEMAND

Buffalo Patents hereby requests a trial by jury on all issues so triable by right.

PRAYER FOR RELIEF

Buffalo Patents requests that the Court find in its favor and against TCL, and that the

Court grant Buffalo Patents the following relief:

a. Judgment that one or more claims of the '670 Patent, the '915 Patent, the '328 Patent, and the '816 Patent have been infringed, either literally and/or under the doctrine of equivalents, by TCL and/or all others acting in concert therewith;

b. A permanent injunction enjoining TCL and its officers, directors, agents, servants, affiliates, employees, divisions, branches, subsidiaries, parents, and all others acting in concert therewith from infringement of the '670 Patent; or, in the alternative, an award of a reasonable ongoing royalty for future infringement of the '670 Patent by such entities;

c. Judgment that TCL account for and pay to Buffalo Patents all damages to and costs incurred by Buffalo Patents because of TCL's infringing activities and other conduct complained of herein, including an award of all increased damages to which Buffalo Patents is entitled under 35 U.S.C. § 284;

d. That Buffalo Patents be granted pre-judgment and post-judgment interest on the damages caused by TCL's infringing activities and other conduct complained of herein;

e. That this Court declare this an exceptional case and award Buffalo Patents its reasonable attorney's fees and costs in accordance with 35 U.S.C. § 285; and

f. That Buffalo Patents be granted such other and further relief as the Court may deem just and proper under the circumstances.

Dated: October 13, 2021

Respectfully submitted,

/s/ Zachariah S. Harrington

Matthew J. Antonelli

Texas Bar No. 24068432

matt@ahtlawfirm.com

Zachariah S. Harrington

Texas Bar No. 24057886

zac@ahtlawfirm.com
Larry D. Thompson, Jr.
Texas Bar No. 24051428
larry@ahtlawfirm.com
Christopher Ryan Pinckney
Texas Bar No. 24067819
ryan@ahtlawfirm.com
Rehan M. Safiullah
Texas Bar No. 24066017
rehan@ahtlawfirm.com

ANTONELLI, HARRINGTON
& THOMPSON LLP
4306 Yoakum Blvd., Ste. 450
Houston, TX 77006
(713) 581-3000

Attorneys for Buffalo Patents, LLC