IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
SHERMAN DIVISION

FAR NORTH PATENTS, LLC, Plaintiff, v. DASAN ZHONE SOLUTIONS, INC., Defendants.	CIVIL ACTION NO. 4:20-cv-823 ORIGINAL COMPLAINT FOR PATENT INFRINGEMENT **JURY TRIAL DEMANDED**

ORIGINAL COMPLAINT FOR PATENT INFRINGEMENT

Plaintiff Far North Patents, LLC ("Far North Patents" or "Plaintiff") files this original complaint against Defendant Dasan Zhone Solutions, Inc. ("Zhone"), 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. Far North Patents is a limited liability company formed under the laws of the State of Texas, with its principal place of business at 18383 Preston Rd Suite 250, Dallas, Texas, 75252.

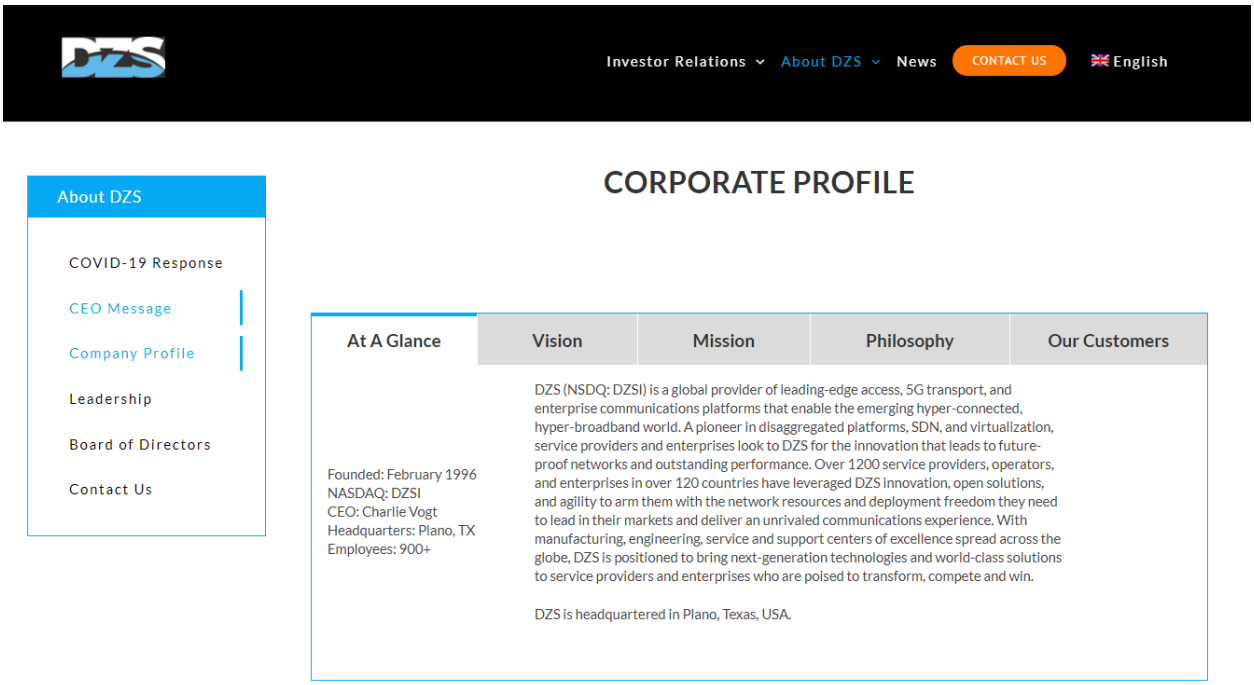
2. Dasan Zhone Solutions, Inc. is a corporation duly organized and existing under the laws of Delaware. Dasan Zhone Solutions, Inc. may be served through its registered agent CT Corporation System, at 1999 Bryan Street, Suite 900, Dallas, Texas 75201.

JURISDICTION AND VENUE

3. 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).

4. This Court has personal jurisdiction over Zhone pursuant to due process and/or the Texas Long Arm Statute because, *inter alia*, (i) Zhone has done and continues to do business in Texas; (ii) Zhone has committed and continues 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; and (iii) Zhone is registered to do business in Texas.

5. Venue is proper in this district pursuant to 28 U.S.C. § 1400(b). Venue is further proper because Zhone has committed and continues 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, inducing others to commit acts of patent infringement in Texas, and/or committing at least a portion of any other infringements alleged herein in this district. Zhone has regular and established places of business in this district, including at least at its headquarters in Plano, Texas, as shown in the below screenshots:



(Source: https://investor-dzsi.com/about/)

A longtime North Texas telecommunications executive will become the new CEO of a recent California-to-Texas corporate transplant, Dasan Zhone Solutions.

Charlie Vogt joins broadband equipment maker DZS from ATX Networks, which makes network equipment to connect smart devices. He succeeds Yung Kim, who's retiring after a 40-year career, including the last four leading DZS, a publicly traded company with $306 million in revenue last year.

DZS announced in March that it was moving its corporate headquarters from Oakland to Plano, where it planned to launch an engineering center to focus on innovation in the 5G space and other technologies, including software-defined access, network functions virtualization and next-generation fiber access.

(Source: https://www.dallasnews.com/business/technology/2020/08/03/north-texas-executive-becomes-new-ceo-of-recent-california-corporate-transplant/)

BACKGROUND

6. The patents-in-suit generally pertain to techniques for delivering high speed internet connections and other advanced communication services. The technology disclosed by the patents was developed by personnel at 3Com Corporation ("3Com").

7. 3Com was a U.S. telecommunications and consumer electronics company. Listed on the NASDAQ, 3Com made the Fortune 500 list in five separate years. 3Com was a major contributor to Ethernet technology as well as other technology enabling high speed internet connections. The patents developed at 3Com ("the Lewin patents") relate to very high speed digital subscriber line ("VDSL") technology. The technology is used in various types of VDSL equipment including customer premise equipment such as DSL modems and provider equipment such as digital subscriber line access multiplexers ("DSLAMs").

8. The Lewin patents have been cited during patent prosecution by numerous leading companies in the communications industry, including Altera, AT&T, Bell Canada, Canon, Cisco, Huawei, Infineon, IBM, Samsung, Southwestern Bell, Semiconductor Energy Laboratory, Serconet, Siemens, Via Technologies, and ZTE.

COUNT I

DIRECT INFRINGEMENT OF U.S. PATENT NO. 8,031,707

9. On October 4, 2011, United States Patent No. 8,031,707 ("the '707 Patent") was duly and legally issued by the United States Patent and Trademark Office for an invention entitled "System for Transporting Ethernet Frames Over Very High Speed Digital Subscriber Lines."

10. Far North Patents is the owner of the '707 Patent, with all substantive rights in and to that patent, including the sole and exclusive right to prosecute this action and enforce the '707 Patent against infringers, and to collect damages for all relevant times.

11. Zhone made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its Zhone 6700-W1 Modem/Router family of products, that include VDSL2 capabilities ("accused products"):

VDSL2-6712-W1

Category: CPE

(Source : https://dzsi.com/product/vdsl2-6712-w1/)

Description

6712-W1 is a versatile Broadband gateway for network service providers that are seeking a single hardware that can support ultra-high bandwidth application.

VDSL2 technology providing up to 100Mbps downstream and 50Mbps upstream (profile 17a) can be used to provide video/data services or triple-play services.

ISP can use the same gateway for FTTx deployment by using the Gigabit Ethernet WAN to a GPON device.

For majority of the ISP that are still using ADSL2+ technology, the same unit can be deployed in ADSL2+ network and switch over to VDSL2 when the network while planning the network upgrade.

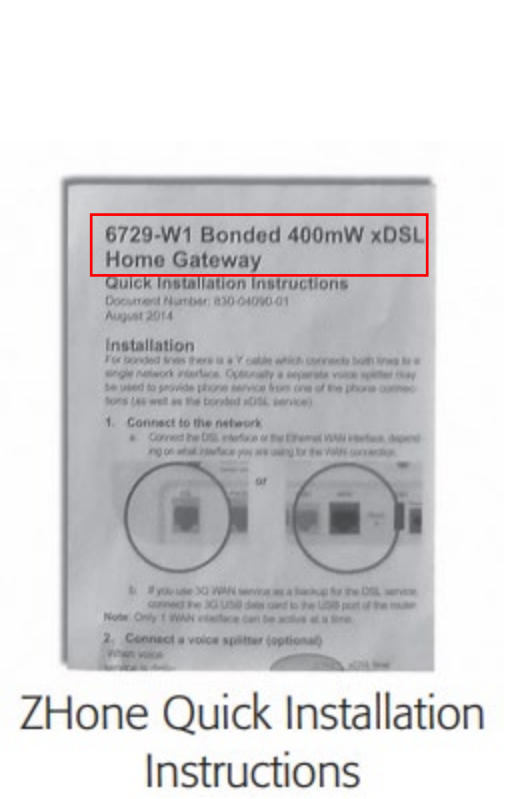
Service Provider can deploy the 6700-W1 series in ADSL2 mode while planning to upgrade the network to VDSL2. Using VDSL2 mode, the 6700-W1 series can support downstream connection rate at 100mbps and 50mpbs upstream for triple play application.

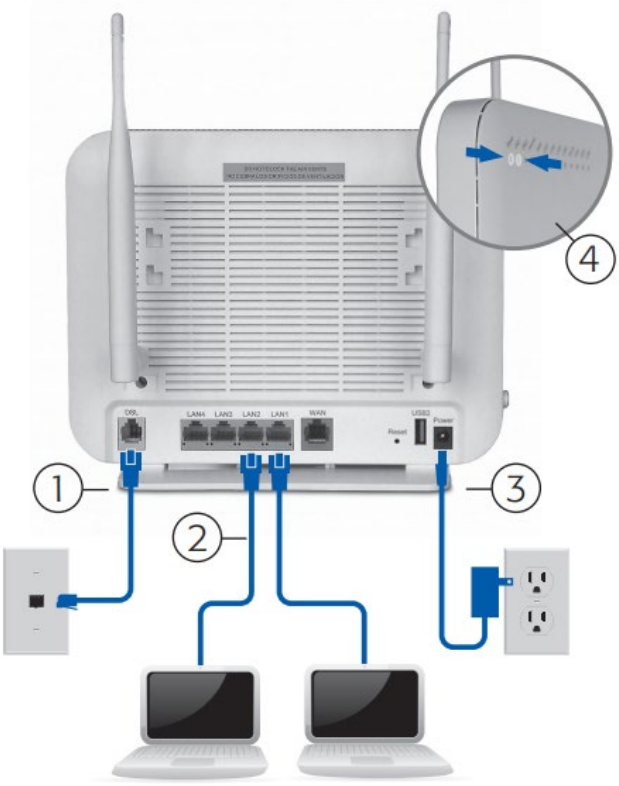
Subscriber can enjoy always-on internet service even when DSL service is down by connecting a USB 3G dongle to one of the USB port provided by the 6700-W1 series.

Inside the home, the 6712-W1 plays a central role in interconnecting all networking devices such as PCs, and game consoles to the internet. The built-in DLNA server makes sharing digital multimedia files and USB printer via the USB ports.

(Source : https://dzsi.com/product/vdsl2-6712-w1/)

(Source : https://www.consolidated.com/Portals/0/Support/Residential Support/High-Speed Internet/Internet Installation and Modem Guides/ZhoneConfig/Zhone 6729 Install Guide.pdf)





(Source : https://www.consolidated.com/Portals/0/Support/Residential Support/High-Speed Internet/Internet Installation and Modem Guides/ZhoneConfig/Zhone 6729 Install Guide.pdf)

Zhone – 6729-W1 – xDSL-Bonding 4-Port 802.11B/G/N Gateway

- VDSL2 pair bonding with Profiles 8a/b/c/d or 12a/b or 17a or ADSL2+ Pair Bonding
- VDSL2 single line with profiles 8a/b/c/d, 12a/b, 17a or 30a or ADSL2/2+
- Supports G.Vector and G.INP
- Integrated Gig-E Ethernet port for GPON development
- Supports IEEE 802.11b/g/n WiFi with 2-builtin transmitter and receiver antennae
- High power WiFi (400mW) for better WiFi coverage
- 4 Gig-E LAN Ports

1 Add to Quote

SKU: 6729-W1 Categories: Dasan Zhone Solutions, Modem Products, VDSL2, Customer Premise Equipment (CPE), Set-top Boxes (STB), Cable Modems, Data, Routers, Dasan Zhone Router, Wireless

(Source : https://www.multicominc.com/product/zhone-6729-w1-xdsl-bonding-4-port-802-11bgn-gateway/)

12. By doing so, Zhone has directly infringed (literally and/or under the doctrine of equivalents) at least Claim 1 of the '707 Patent. Zhone's infringement in this regard is ongoing.

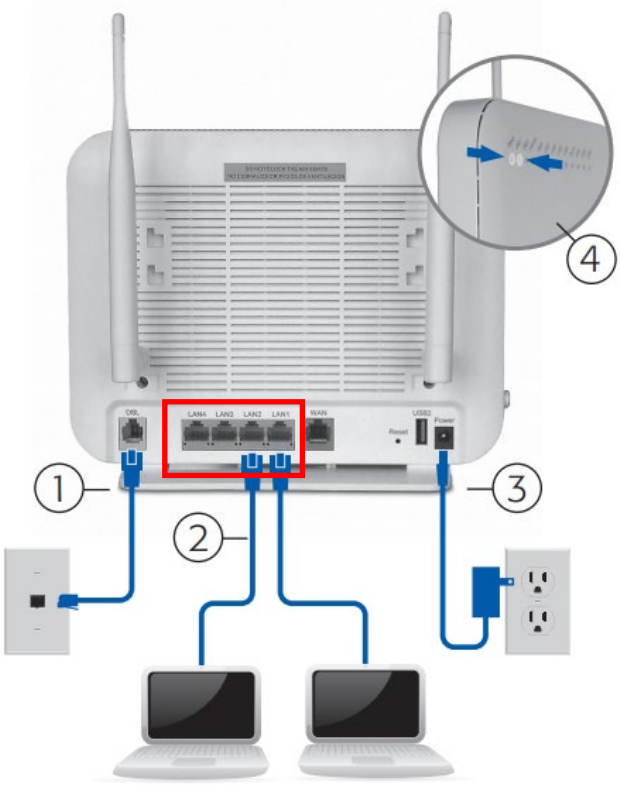
13. Zhone has infringed the '707 Patent by making, having made, using, importing, providing, supplying, distributing, selling or offering for sale products including an apparatus comprising an Ethernet transceiver configured to receive an Ethernet frame from a source. For example, the Accused Products are used by Defendant to implement the ITU-T G.993.2

recommendation. The Recommendation specified by ITU-T G.993.2 includes a VTU (VDSL2 Transceiver Unit) functional model that transports ethernet packets using a very high-speed digital subscriber line (VDSL). The model includes an application specific layer comprising Transport Protocol Specific - Transmission Convergence (TPS-TC) sub-layers. The TPS-TC layers support transport of ethernet packets using ATM-TC (Asynchronous Transfer Mode – Transmission Convergence). Also, the ITU-T G.993.2 standard recommends transfer of ethernet packets using PTM-TC (Packet Transfer Mode – Transmission Convergence). Further, the signals sent from the TPS-TC layer, either using ATM-TC or PTM-TC are converted into a unified format i.e., the signals from TPS-TC layer are application-independent in the subsequent layers of transmission. The ethernet packets are transported, so they are transmitted from an ethernet transmitter to an ethernet receiver. Both ethernet transmitter and ethernet receiver constitutes an ethernet transceiver which receives Ethernet frames from an Ethernet source such as a computer with a network card.

VDSL2-6712-W1

Category: CPE

(Source : https://dzsi.com/product/vdsl2-6712-w1/)



(Source : https://www.consolidated.com/Portals/0/Support/Residential Support/High-Speed Internet/Internet Installation and Modem Guides/ZhoneConfig/Zhone 6729 Install Guide.pdf)

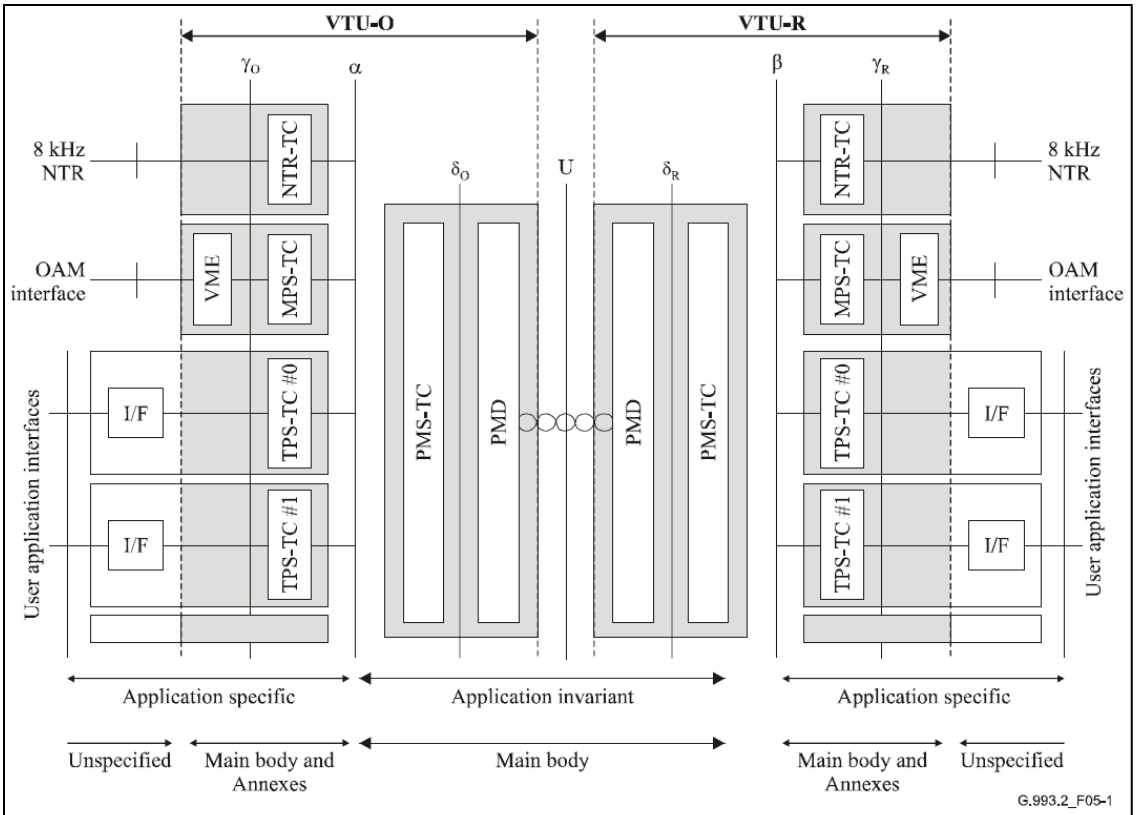


Figure 5-1/G.993.2 – VDSL2 and VTU functional model

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

8.1.1 User data TPS-TC types

There are three types of user data TPS-TCs defined in this Recommendation:

- Type 1: STM transport (STM-TC);
- Type 2: ATM transport (ATM-TC); and
- Type 3: Ethernet and generic packet transport (PTM-TC).

Each of these three types is defined as an application option. The VTU-O selects the user data TPS-TC type for each bearer channel, both upstream and downstream, based on the type of higher layer data it chooses to support on that bearer channel. The enabled user data TPS-TC type for each of the bearer channels is indicated during initialization.

Functionality, parameters, and application interface (γ interface) characteristics of the user data TPS-TCs supporting STM transport (STM-TC), ATM transport (ATM-TC), and ethernet and generic packet transport (PTM-TC) are specified in K.1, K.2 and K.3, respectively.

The transmit signals of the TPS-TC are submitted to the α/β interface. Signals passing via the α/β interface in both directions have an application-independent (transport protocol independent) format, as specified in 8.1.2. The particular bit rates for each of the multiplexed TPS-TCs at the α/β reference point are determined during system configuration.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

K.3 Packet transmission convergence function (PTM-TC)

K.3.1 Scope

The PTM-TC is intended for Ethernet transport and generic packet transport. The PTM-TC function provides procedures for the transport of one PTM-TC stream in either the upstream or downstream direction. Packet boundaries, octet boundaries, and the position of most significant bits are explicitly maintained across the transport for the PTM-TC stream. The PTM-TC stream is presented asynchronously across the γ_R or γ_O reference point with respect to the synchronization signals across the α/β interface.

The reference model, functionality, and γ interface of the PMS-TC are defined in Annex N/G.992.3 [10]. Referring to the reference model of Annex N/G.992.3 [10], the PTM-TC function of VDSL2 could be established over either of the enabled bearer channels.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

14. The accused products include a very high speed digital subscriber line (VDSL) transceiver configured to transmit on at least one VDSL link, wherein a VDSL protocol for the VDSL link defines a fixed size for each VDSL frame to be transmitted on the VDSL link. For example, the Accused Products are used by Defendant to implement the ITU-T G.993.2

recommendation. The Recommendation ITU-T G.993.2 includes VTU (VDSL2 transceiver unit) to transmit the user data using TPS-TC layers. The VTU further supports mapping of all TPS-TC types to all bearer channels that carry main data i.e. each VDSL link that transports user data supports multiple protocols. One such transport protocol is ATM-TC (VDSL protocol). ATM-TC protocol defines procedures for transporting ethernet frames that are encapsulated into ATM cells (VDSL frames) over VDSL links. Each ATM cell has a fixed length of 53 octets (fixed size) and is transported via VDSL link.

VDSL2-6712-W1

Category: CPE

(Source : https://dzsi.com/product/vdsl2-6712-w1/)

Description

6712-W1 is a versatile Broadband gateway for network service providers that are seeking a single hardware that can support ultra-high bandwidth application.

VDSL2 technology providing up to 100Mbps downstream and 50Mbps upstream (profile 17a) can be used to provide video/data services or triple-play services.

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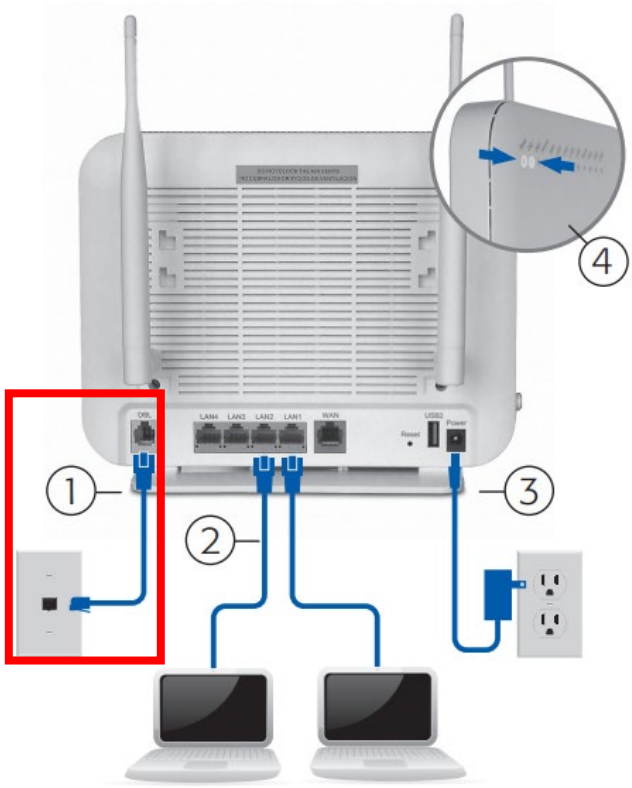
Service Provider can deploy the 6700-W1 series in ADSL2 mode while planning to upgrade the network to VDSL2. Using VDSL2 mode, the 6700-W1 series can support downstream connection rate at 100mbps and 50mpbs upstream for triple play application.

Subscriber can enjoy always-on internet service even when DSL service is down by connecting a USB 3G dongle to one of the USB port provided by the 6700-W1 series.

Inside the home, the 6712-W1 plays a central role in interconnecting all networking devices such as PCs, and game consoles to the internet. The built-in DLNA server makes sharing digital multimedia files and USB printer via the USB ports.

(Source : https://dzsi.com/product/vdsl2-6712-w1/)



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Zhone – 6729-W1 – xDSL-Bonding 4-Port 802.11B/G/N Gateway

- VDSL2 pair bonding with Profiles 8a/b/c/d or 12a/b or 17a or ADSL2+ Pair Bonding
- VDSL2 single line with profiles 8a/b/c/d, 12a/b, 17a or 30a or ADSL2/2+
- Supports G.Vector and G.INP
- Integrated Gig-E Ethernet port for GPON development
- Supports IEEE 802.11b/g/n WiFi with 2-builtin transmitter and receiver antennae
- High power WiFi (400mW) for better WiFi coverage
- 4 Gig-E LAN Ports

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SKU: 6729-W1 Categories: Dasan Zhone Solutions, Modem Products, VDSL2, Customer Premise Equipment (CPE), Set-top Boxes (STB), Cable Modems, Data, Routers, Dasan Zhone Router, Wireless

(Source : https://www.multicominc.com/product/zhone-6729-w1-xdsl-bonding-4-port-802-11bgn-gateway/)

8.1 The user data TPS-TC

8.1.1 User data TPS-TC types

There are three types of user data TPS-TCs defined in this Recommendation:

- Type 1: STM transport (STM-TC);
- Type 2: ATM transport (ATM-TC); and
- Type 3: Ethernet and generic packet transport (PTM-TC).

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

VDSL	Very High Speed Digital Subscriber Line
VME	VDSL2 Management Entity
VTU	VDSL2 Transceiver Unit
VTU-O	VTU at the ONU (or central office, exchange, cabinet, etc., i.e., operator end of the loop)
VTU-R	VTU at the remote site (i.e., subscriber end of the loop)

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

A VTU shall support mapping of all supported TPS-TC types to all supported bearer channels, except that PTM on one bearer channel and ATM on the other bearer channel shall not be enabled simultaneously. The valid labelling of supported bearer channels shall start from 0 and increase by

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

ATM-TC

G.1 Scope

This annex specifies a VDSL ATM Transport Protocol Specific Transmission Convergence sublayer (ATM-TC), which describes the ATM based service transmission over a VDSL link. This annex defines a minimum set of requirements to deliver an ATM service from the ONU to the remote customer premises. It is based on the ITU-T Recs. I.432.x. The ATM-TC specification is applicable at both the VTU-O side and the VTU-R side.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.1-200111-S!!PDF-E&type=items)

G.4.1.1 Data flow

The Data flow consists of two streams of 53 octet ATM cells each (Tx ATM, Rx ATM) with independent rates flowing in opposite directions. Rate values are arbitrary under a predefined upper limit of aggregate channel capacity determined by the data rate at the corresponding α (or β) interface. The Data flow signal description is presented in Table G.1.

The ATM cell format is identical in both transmit and receive directions: 52 out of the 53 octets carry ATM layer data (user data). Octet number 5 is undefined (intended for HEC insertion in the TC sublayer).

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.1-200111-S!!PDF-E&type=items)

and I.2 and shown in Figure I.1. When a flow control flag is activated by the VTU-O (i.e. the VTU-O wants to transmit or receive a cell), the ATM layer initiates a cell Tx or cell Rx cycle (53 byte transfer). The VTU supports transfer of a complete cell within 53 consecutive clock cycles.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.1-200111-S!!PDF-E&type=items)

lation). At present, the most common solution for transporting Ethernet frames over DSL is bridged IP DSLAM, where Ethernet frames are assembled into ATM adaptation layer 5 (AAL5) and encapsulated into ATM cells before they are sent to the DSL physical link (Figure 11). The Segmentation and Reassembly (SAR) block processes the Ethernet frames. The ATM cells are transported over a UTOPIA (universal test and operations PHY interface for ATM) L2 electrical interface to an application-specific interface called the ATM TPS-TC (transport protocol-specific – transmission convergence). TSP-TC is also sometimes denoted ATM-TC, for example, in the context of the xTU-C (xDSL transceiver unit – central office).

(Source: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.468.597&rep=rep1&type=pdf)

15. The accused products include an encapsulation unit coupled to the Ethernet transceiver and the VDSL transceiver, wherein the encapsulation unit is configured to encapsulate the Ethernet frame in a corresponding frame. For example, the Accused Products are used by Defendant to implement the ITU-T G.993.2 recommendation. The TPS-TC layers support transport of various types of user data. According to ITU-T G.993.2, ethernet packet is

one of the user data types transported using Packet transmission convergence function (PTM-TC) function. The PTM-TC function provides procedures for transporting ethernet packets. The ethernet packets are transported, so the packets are transmitted from an ethernet transmitter to an ethernet receiver. Both ethernet transmitter and ethernet receiver constitutes an ethernet transceiver. Further, the PTM-TC function mentioned in the recommendation ITU-T G.993.2 is used for transporting ethernet frames using VDSL transceiver unit (VTU). Also, the PTM-TC encapsulates the ethernet frame into a PTM-TC frame (corresponding frame) by appending CRC to each ethernet frame. The hardware and/or software implementing this functionality is an encapsulation unit.

K.3 Packet transmission convergence function (PTM-TC)

K.3.1 Scope

The PTM-TC is intended for Ethernet transport and generic packet transport. The PTM-TC function provides procedures for the transport of one PTM-TC stream in either the upstream or downstream direction. Packet boundaries, octet boundaries, and the position of most significant bits are explicitly maintained across the transport for the PTM-TC stream. The PTM-TC stream is presented asynchronously across the γ_R or γ_O reference point with respect to the synchronization signals across the α/β interface.

The reference model, functionality, and γ interface of the PMS-TC are defined in Annex N/G.992.3 [10]. Referring to the reference model of Annex N/G.992.3 [10], the PTM-TC function of VDSL2 could be established over either of the enabled bearer channels.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

K.3.8 Functionality

The functionality of the PTM-TC shall implement 64/65-octet encapsulation as defined in Annex N/G.992.3 [10], and shall include encapsulation, packet error monitoring, data rate decoupling, and frame delineation.

For frame error monitoring, the transmitting PTM-TC shall insert the 16-bit CRC defined in N.3.3/G.992.3 [10].

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

Annex N

64/65-octet PTM-TC sublayer functional specifications

N.1 Scope

The PTM-TC shall provide full transparent transfer of packets between the γ reference points at network and premises side (except non-correctable errors caused by the transmission medium). It shall also provide packet integrity and packet error monitoring capability.

In the transmit direction, the PTM-TC receives packets from the higher layer PTM entity via the γ-interface. An additional CRC is calculated on the packet and appended (to construct a PTM-TC frame). The PTM-TC then performs 64/65-octet encapsulation on the frame, and sends the resulting codewords to the PMS-TC via the α/β-interface. In the receive direction, the PTM-TC receives codewords from the PMS-TC via α/β-interface, recovers the transported PTM-TC frame, checks the CRC, and submits the extracted packet to the PTM entity via the γ-interface.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.992.3-200509-S!Amd1!PDF-E&type=items)

16. The accused products include wherein the corresponding frame exceeds the fixed size defined in the VDSL protocol, and wherein the VDSL transceiver is configured to transmit the corresponding frame on the VDSL link even though the corresponding frame exceeds the fixed size. For example, the Accused Products are used by Defendant to implement the ITU-T G.993.2 recommendation. The Recommendation ITU-T G.993.2 includes VTU (VDSL2 transceiver unit) to transmit the user data using TPS-TC layers. The VTU further supports mapping of all TPS-TC types to all bearer channels that carry main data i.e. each VDSL link that transports user data supports multiple protocols. One such transport protocol is ATM-TC (VDSL protocol). ATM-TC protocol defines procedures for transporting ethernet frames that are encapsulated into ATM cells (VDSL frames) over VDSL links. Each ATM cell has a fixed length of 53 octets (fixed size) and is transported via VDSL link. Further, PTM-TC is also responsible to transport ethernet packets. Further, the signals sent from the TPS-TC layer, either using ATM-TC or PTM-TC are converted into a unified format i.e., the signals from TPS-TC layer are application-independent in the subsequent layers of transmission. Ethernet packets,

generally, have a minimum of 64 data bytes. The PTM-TC is configured to encapsulate such ethernet packets into PTM-TC frames (corresponding frame) by appending CRC. The size of the PTM-TC frames therefore exceeds 53 octets (fixed size) defined in ATM-TC (VDSL protocol). The PTM-TC frames are further mapped to transmission frame for transmission over VDSL link. Hence, the VTU is configured to transmit the PTM-TC frame (corresponding frame) on the VDSL link even though the corresponding frame exceeds the fixed size.

8.1.1 User data TPS-TC types

There are three types of user data TPS-TCs defined in this Recommendation:

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- Type 2: ATM transport (ATM-TC); and
- Type 3: Ethernet and generic packet transport (PTM-TC).

Each of these three types is defined as an application option. The VTU-O selects the user data TPS-TC type for each bearer channel, both upstream and downstream, based on the type of higher layer data it chooses to support on that bearer channel. The enabled user data TPS-TC type for each of the bearer channels is indicated during initialization.

Functionality, parameters, and application interface (γ interface) characteristics of the user data TPS-TCs supporting STM transport (STM-TC), ATM transport (ATM-TC), and ethernet and generic packet transport (PTM-TC) are specified in K.1, K.2 and K.3, respectively.

The transmit signals of the TPS-TC are submitted to the α/β interface. Signals passing via the α/β interface in both directions have an application-independent (transport protocol independent) format, as specified in 8.1.2. The particular bit rates for each of the multiplexed TPS-TCs at the α/β reference point are determined during system configuration.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

VDSL	Very High Speed Digital Subscriber Line
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VTU-R	VTU at the remote site (i.e., subscriber end of the loop)

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

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ATM-TC

G.1 Scope

This annex specifies a VDSL ATM Transport Protocol Specific Transmission Convergence sublayer (ATM-TC), which describes the ATM based service transmission over a VDSL link. This annex defines a minimum set of requirements to deliver an ATM service from the ONU to the remote customer premises. It is based on the ITU-T Recs. I.432.x. The ATM-TC specification is applicable at both the VTU-O side and the VTU-R side.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.1-200111-S!!PDF-E&type=items)

G.4.1.1 Data flow

The Data flow consists of two streams of 53 octet ATM cells each (Tx_ATM, Rx_ATM) with independent rates flowing in opposite directions. Rate values are arbitrary under a predefined upper limit of aggregate channel capacity determined by the data rate at the corresponding α (or β) interface. The Data flow signal description is presented in Table G.1.

The ATM cell format is identical in both transmit and receive directions: 52 out of the 53 octets carry ATM layer data (user data). Octet number 5 is undefined (intended for HEC insertion in the TC sublayer).

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.1-200111-S!!PDF-E&type=items)

and I.2 and shown in Figure I.1. When a flow control flag is activated by the VTU-O (i.e. the VTU-O wants to transmit or receive a cell), the ATM layer initiates a cell Tx or cell Rx cycle (53 byte transfer). The VTU supports transfer of a complete cell within 53 consecutive clock cycles.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.1-200111-S!!PDF-E&type=items)

K.3 Packet transmission convergence function (PTM-TC)

K.3.1 Scope

The PTM-TC is intended for Ethernet transport and generic packet transport. The PTM-TC function provides procedures for the transport of one PTM-TC stream in either the upstream or downstream direction. Packet boundaries, octet boundaries, and the position of most significant bits are explicitly maintained across the transport for the PTM-TC stream. The PTM-TC stream is presented asynchronously across the γ_R or γ_O reference point with respect to the synchronization signals across the α/β interface.

The reference model, functionality, and γ interface of the PMS-TC are defined in Annex N/G.992.3 [10]. Referring to the reference model of Annex N/G.992.3 [10], the PTM-TC function of VDSL2 could be established over either of the enabled bearer channels.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

K.3.8 Functionality

The functionality of the PTM-TC shall implement 64/65-octet encapsulation as defined in Annex N/G.992.3 [10], and shall include encapsulation, packet error monitoring, data rate decoupling, and frame delineation.

For frame error monitoring, the transmitting PTM-TC shall insert the 16-bit CRC defined in N.3.3/G.992.3 [10].

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

Annex N

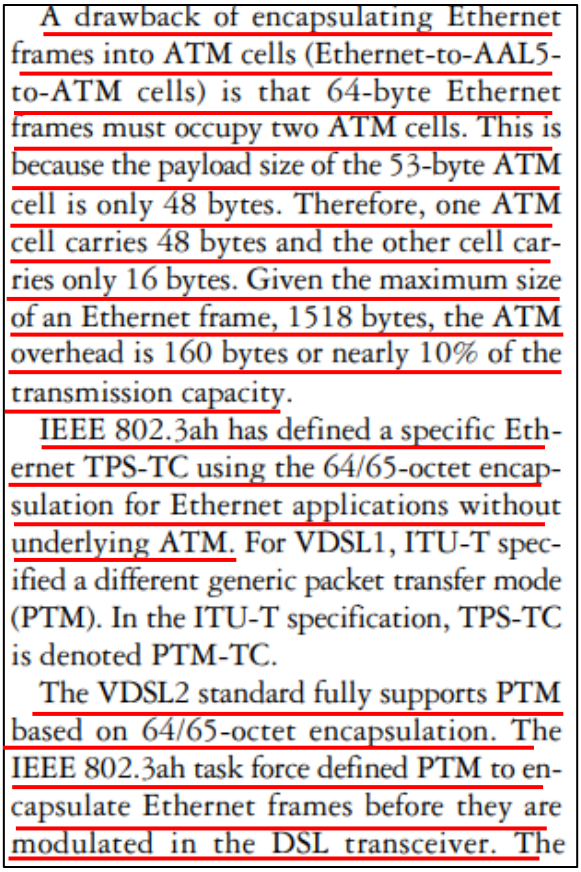
64/65-octet PTM-TC sublayer functional specifications

N.1 Scope

The PTM-TC shall provide full transparent transfer of packets between the γ reference points at network and premises side (except non-correctable errors caused by the transmission medium). It shall also provide packet integrity and packet error monitoring capability.

In the transmit direction, the PTM-TC receives packets from the higher layer PTM entity via the γ-interface. An additional CRC is calculated on the packet and appended (to construct a PTM-TC frame). The PTM-TC then performs 64/65-octet encapsulation on the frame, and sends the resulting codewords to the PMS-TC via the α/β-interface. In the receive direction, the PTM-TC receives codewords from the PMS-TC via α/β-interface, recovers the transported PTM-TC frame, checks the CRC, and submits the extracted packet to the PTM entity via the γ-interface.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.992.3-200509-S!Amd1!PDF-E&type=items)



A drawback of encapsulating Ethernet frames into ATM cells (Ethernet-to-AAL5-to-ATM cells) is that 64-byte Ethernet frames must occupy two ATM cells. This is because the payload size of the 53-byte ATM cell is only 48 bytes. Therefore, one ATM cell carries 48 bytes and the other cell carries only 16 bytes. Given the maximum size of an Ethernet frame, 1518 bytes, the ATM overhead is 160 bytes or nearly 10% of the transmission capacity.

IEEE 802.3ah has defined a specific Ethernet TPS-TC using the 64/65-octet encapsulation for Ethernet applications without underlying ATM. For VDSL1, ITU-T specified a different generic packet transfer mode (PTM). In the ITU-T specification, TPS-TC is denoted PTM-TC.

The VDSL2 standard fully supports PTM based on 64/65-octet encapsulation. The IEEE 802.3ah task force defined PTM to encapsulate Ethernet frames before they are modulated in the DSL transceiver. The

(Source: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.468.597&rep=rep1&type=pdf)

17. Zhone has had knowledge of the '707 Patent at least as of the date when it was notified of the filing of this action.

18. Far North Patents has been damaged as a result of the infringing conduct by Zhone alleged above. Thus, Zhone is liable to Far North 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.

19. Far North Patents and/or its predecessors-in-interest have satisfied all statutory obligations required to collect pre-filing damages for the full period allowed by law for infringement of the '707 Patent.

COUNT II

DIRECT INFRINGEMENT OF U.S. PATENT NO. 9,178,985

20. On November 3, 2015, United States Patent No. 9,178,985 ("the '985 Patent") was duly and legally issued by the United States Patent and Trademark Office for an invention entitled "System for Transporting Ethernet Frames Over Very High Speed Digital Subscriber Lines."

21. Far North Patents is the owner of the '985 Patent, with all substantive rights in and to that patent, including the sole and exclusive right to prosecute this action and enforce the '985 Patent against infringers, and to collect damages for all relevant times.

22. Zhone made, had made, used, imported, provided, supplied, distributed, sold, and/or offered for sale products and/or systems including, for example, its Zhone 6700-W1 Modem/Router family of products, that include VDSL2 capabilities ("accused products"):

VDSL2-6712-W1

Category: CPE

(Source : https://dzsi.com/product/vdsl2-6712-w1/)

Description

6712-W1 is a versatile Broadband gateway for network service providers that are seeking a single hardware that can support ultra-high bandwidth application.

VDSL2 technology providing up to 100Mbps downstream and 50Mbps upstream (profile 17a) can be used to provide video/data services or triple-play services.

ISP can use the same gateway for FTTx deployment by using the Gigabit Ethernet WAN to a GPON device.

For majority of the ISP that are still using ADSL2+ technology, the same unit can be deployed in ADSL2+ network and switch over to VDSL2 when the network while planning the network upgrade.

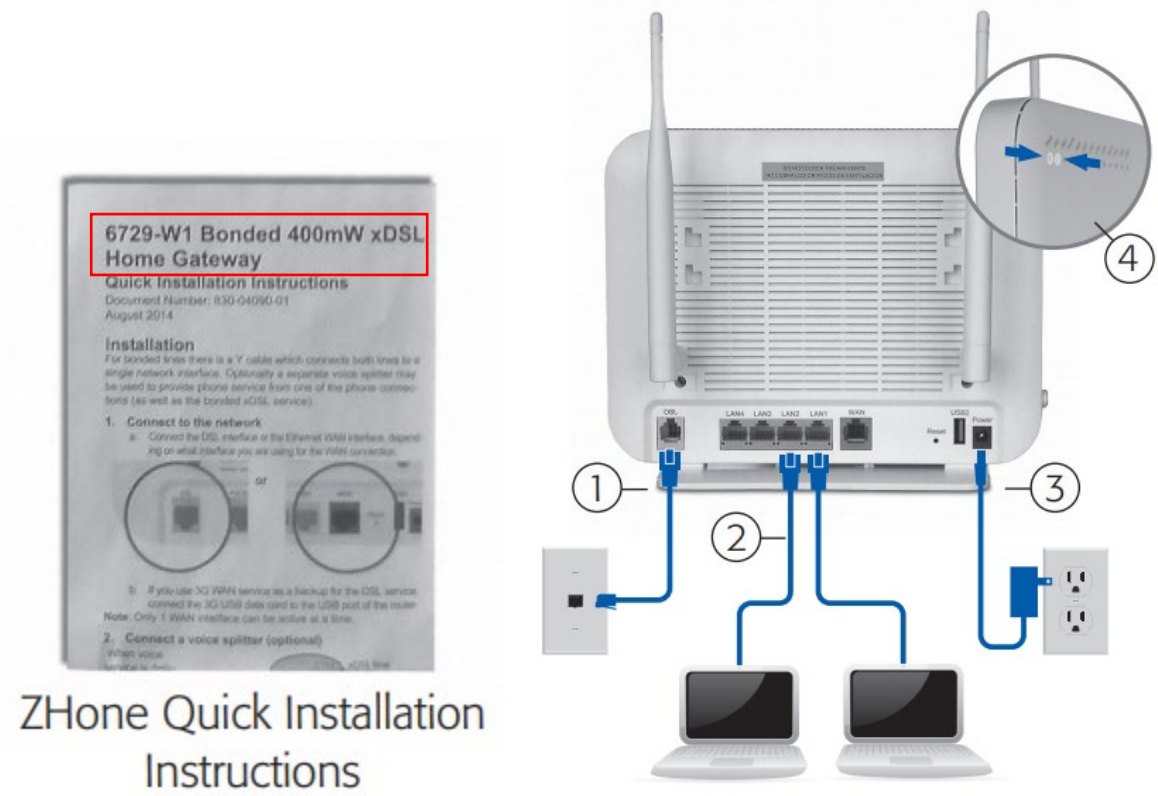
Service Provider can deploy the 6700-W1 series in ADSL2 mode while planning to upgrade the network to VDSL2. Using VDSL2 mode, the 6700-W1 series can support downstream connection rate at 100mbps and 50mpbs upstream for triple play application.

Subscriber can enjoy always-on internet service even when DSL service is down by connecting a USB 3G dongle to one of the USB port provided by the 6700-W1 series.

Inside the home, the 6712-W1 plays a central role in interconnecting all networking devices such as PCs, and game consoles to the internet. The built-in DLNA server makes sharing digital multimedia files and USB printer via the USB ports.

(Source : https://dzsi.com/product/vdsl2-6712-w1/)

(Source : https://www.consolidated.com/Portals/0/Support/Residential Support/High-Speed Internet/Internet Installation and Modem Guides/ZhoneConfig/Zhone 6729 Install Guide.pdf)



(Source : https://www.consolidated.com/Portals/0/Support/Residential Support/High-Speed Internet/Internet Installation and Modem Guides/ZhoneConfig/Zhone 6729 Install Guide.pdf)

Zhone – 6729-W1 – xDSL-Bonding 4-Port 802.11B/G/N Gateway

- VDSL2 pair bonding with Profiles 8a/b/c/d or 12a/b or 17a or ADSL2+ Pair Bonding
- VDSL2 single line with profiles 8a/b/c/d, 12a/b, 17a or 30a or ADSL2/2+
- Supports G.Vector and G.INP
- Integrated Gig-E Ethernet port for GPON development
- Supports IEEE 802.11b/g/n WiFi with 2-builtin transmitter and receiver antennae
- High power WiFi (400mW) for better WiFi coverage
- 4 Gig-E LAN Ports

1 Add to Quote

SKU: 6729-W1 Categories: Dasan Zhone Solutions, Modem Products, VDSL2, Customer Premise Equipment (CPE), Set-top Boxes (STB), Cable Modems, Data, Routers, Dasan Zhone Router, Wireless

(Source : https://www.multicominc.com/product/zhone-6729-w1-xdsl-bonding-4-port-802-11bgn-gateway/)

23. By doing so, Zhone has directly infringed (literally and/or under the doctrine of equivalents) at least Claim 1 of the '985 Patent.

24. Zhone has infringed the '985 Patent by using the accused products and thereby practicing a method of encapsulating Ethernet frames onto a Very high speed Digital Subscriber Line (VDSL) facility. For example, the Accused Products are used by Defendant to implement the ITU-T G.993.2 recommendation. The Recommendation specified by ITU-T G.993.2

includes a VTU (VDSL2 Transceiver Unit) functional model that encapsulates and transports ethernet packets using very a high-speed digital subscriber line (VDSL) facility. The model includes an application specific layer comprising Transport Protocol Specific - Transmission Convergence (TPS-TC) sub-layers. The TPS-TC layers support transport of ethernet packets using ATM-TC (Asynchronous Transfer Mode – Transmission Convergence). Also, the ITU-T G.993.2 standard recommends transfer of ethernet packets using PTM-TC (Packet Transfer Mode – Transmission Convergence). Further, the signals sent from the TPS-TC layer, either using ATM-TC or PTM-TC are converted into a unified format i.e., the signals from TPS-TC layer are application-independent in the subsequent layers of transmission. The ethernet packets are transported, so they are transmitted from an ethernet transmitter to an ethernet receiver. Both ethernet transmitter and ethernet receiver constitutes an ethernet transceiver which receives Ethernet frames from an Ethernet source such as a computer with a network card.

VDSL2-6712-W1

Category: CPE

(Source : https://dzsi.com/product/vdsl2-6712-w1/)

Description

6712-W1 is a versatile Broadband gateway for network service providers that are seeking a single hardware that can support ultra-high bandwidth application.

VDSL2 technology providing up to 100Mbps downstream and 50Mbps upstream (profile 17a) can be used to provide video/data services or triple-play services.

ISP can use the same gateway for FTTx deployment by using the Gigabit Ethernet WAN to a GPON device.

For majority of the ISP that are still using ADSL2+ technology, the same unit can be deployed in ADSL2+ network and switch over to VDSL2 when the network while planning the network upgrade.

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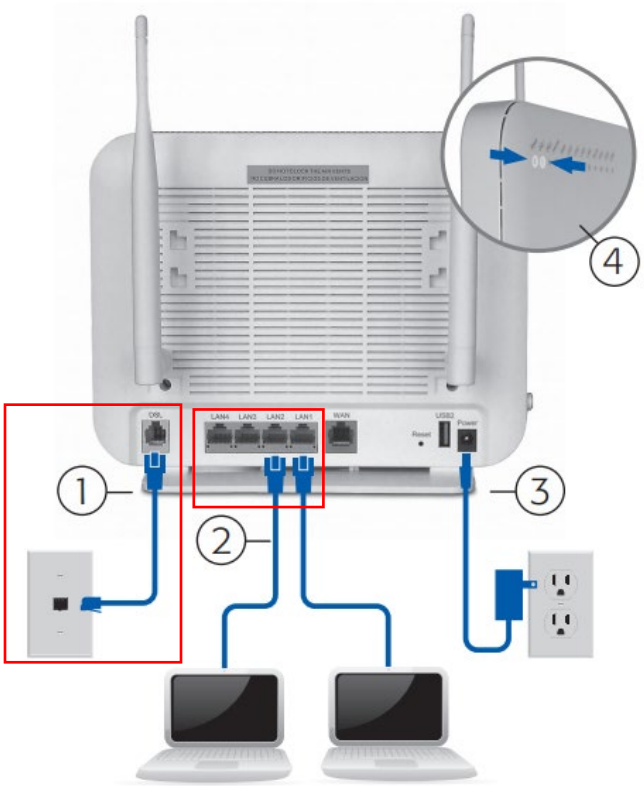
Inside the home, the 6712-W1 plays a central role in interconnecting all networking devices such as PCs, and game consoles to the internet. The built-in DLNA server makes sharing digital multimedia files and USB printer via the USB ports.

(Source : https://dzsi.com/product/vdsl2-6712-w1/)



(Source : https://www.consolidated.com/Portals/0/Support/Residential Support/High-Speed Internet/Internet Installation and Modem Guides/ZhoneConfig/Zhone 6729 Install Guide.pdf)

Zhone – 6729-W1 – xDSL-Bonding 4-Port 802.11B/G/N Gateway

- VDSL2 pair bonding with Profiles 8a/b/c/d or 12a/b or 17a or ADSL2+ Pair Bonding
- VDSL2 single line with profiles 8a/b/c/d, 12a/b, 17a or 30a or ADSL2/2+
- Supports G.Vector and G.INP
- Integrated Gig-E Ethernet port for GPON development
- Supports IEEE 802.11b/g/n WiFi with 2-builtin transmitter and receiver antennae
- High power WiFi (400mW) for better WiFi coverage
- 4 Gig-E LAN Ports

1 Add to Quote

SKU: 6729-W1 Categories: Dasan Zhone Solutions, Modem Products, VDSL2, Customer Premise Equipment (CPE), Set-top Boxes (STB), Cable Modems, Data, Routers, Dasan Zhone Router, Wireless

(Source : https://www.multicominc.com/product/zhone-6729-w1-xdsl-bonding-4-port-802-11bgn-gateway/)

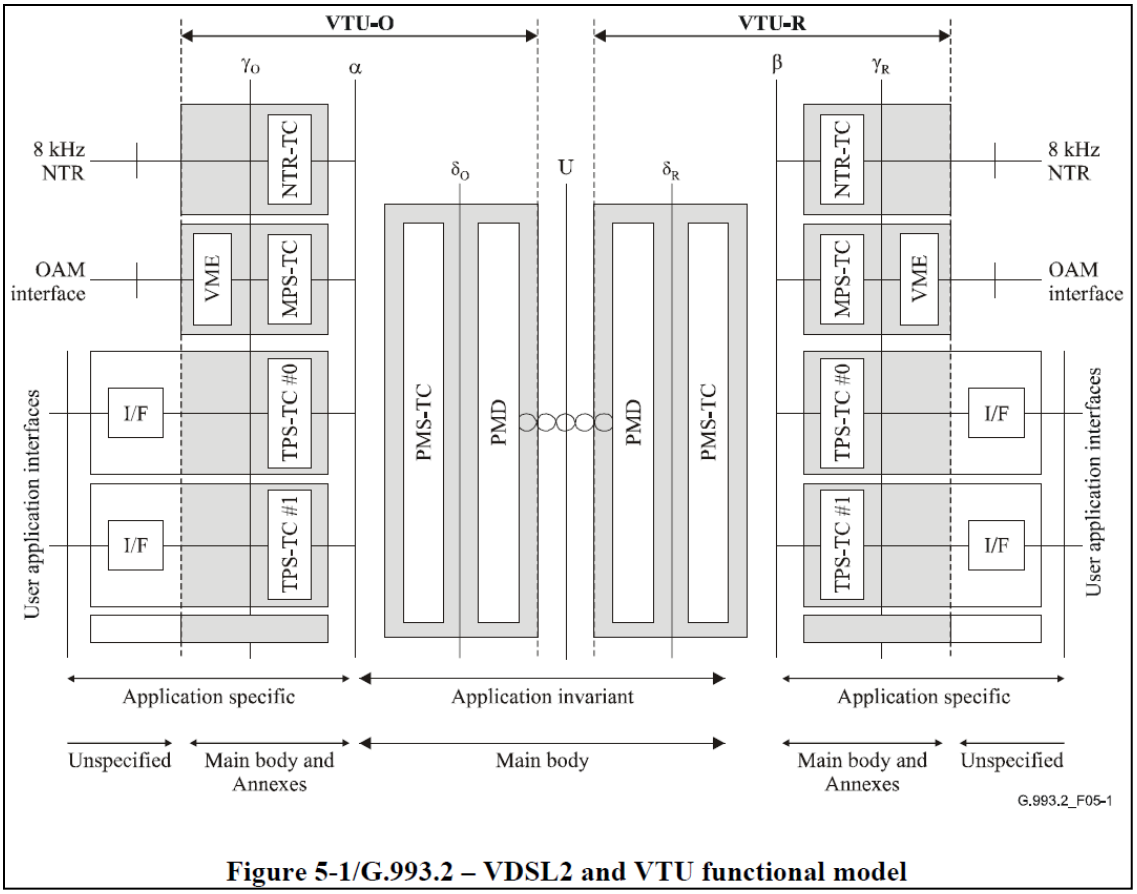


Figure 5-1/G.993.2 – VDSL2 and VTU functional model

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

8.1.1 User data TPS-TC types

There are three types of user data TPS-TCs defined in this Recommendation:

- Type 1: STM transport (STM-TC);
- Type 2: ATM transport (ATM-TC); and
- Type 3: Ethernet and generic packet transport (PTM-TC).

Each of these three types is defined as an application option. The VTU-O selects the user data TPS-TC type for each bearer channel, both upstream and downstream, based on the type of higher layer data it chooses to support on that bearer channel. The enabled user data TPS-TC type for each of the bearer channels is indicated during initialization.

Functionality, parameters, and application interface (γ interface) characteristics of the user data TPS-TCs supporting STM transport (STM-TC), ATM transport (ATM-TC), and ethernet and generic packet transport (PTM-TC) are specified in K.1, K.2 and K.3, respectively.

The transmit signals of the TPS-TC are submitted to the α/β interface. Signals passing via the α/β interface in both directions have an application-independent (transport protocol independent) format, as specified in 8.1.2. The particular bit rates for each of the multiplexed TPS-TCs at the α/β reference point are determined during system configuration.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

K.3 Packet transmission convergence function (PTM-TC)

K.3.1 Scope

The PTM-TC is intended for Ethernet transport and generic packet transport. The PTM-TC function provides procedures for the transport of one PTM-TC stream in either the upstream or downstream direction. Packet boundaries, octet boundaries, and the position of most significant bits are explicitly maintained across the transport for the PTM-TC stream. The PTM-TC stream is presented asynchronously across the γ_R or γ_O reference point with respect to the synchronization signals across the α/β interface.

The reference model, functionality, and γ interface of the PMS-TC are defined in Annex N/G.992.3 [10]. Referring to the reference model of Annex N/G.992.3 [10], the PTM-TC function of VDSL2 could be established over either of the enabled bearer channels.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

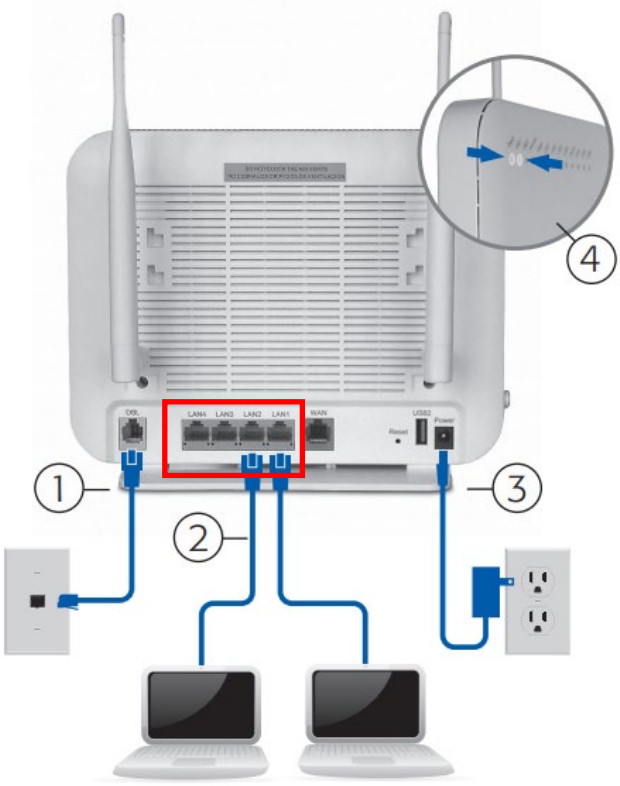
25. The methods practiced by Zhone's use of the accused products include receiving Ethernet frames from an Ethernet source and storing said Ethernet frames for subsequent forwarding. For example, the Accused Products are used by Defendant to implement the ITU-T G.993.2 recommendation. The Recommendation specified by ITU-T G.993.2 includes a VTU (VDSL2 Transceiver Unit) functional model that encapsulates and transports ethernet packets using very a high-speed digital subscriber line (VDSL) facility. The model includes an application specific layer comprising Transport Protocol Specific - Transmission Convergence (TPS-TC) sub-layers. The TPS-TC layers support transport of ethernet packets using ATM-TC (Asynchronous Transfer Mode – Transmission Convergence). Also, the ITU-T G.993.2 standard recommends transfer of ethernet packets using PTM-TC (Packet Transfer Mode – Transmission Convergence). Further, the signals sent from the TPS-TC layer, either using ATM-TC or PTM-TC are converted into a unified format i.e., the signals from TPS-TC layer are application-independent in the subsequent layers of transmission. The ethernet packets are transported, so

they are transmitted from an ethernet transmitter to an ethernet receiver. Both ethernet transmitter and ethernet receiver constitutes an ethernet transceiver which receives Ethernet frames from an Ethernet source such as a computer with a network card. The PTM-TC of VTU (VDSL2 Transceiver Unit) is intended to transport ethernet frames. Ethernet frames are transmitted to an ethernet receiver, and those ethernet frames are stored in a memory at least by the BCM63168 DSL System on a Chip that is in the Accused Products.

VDSL2-6712-W1

Category: CPE

(Source : https://dzsi.com/product/vdsl2-6712-w1/)



(Source : https://www.consolidated.com/Portals/0/Support/Residential Support/High-Speed Internet/Internet Installation and Modem Guides/ZhoneConfig/Zhone 6729 Install Guide.pdf)

Zhone – 6729-W1 – xDSL-Bonding 4-Port 802.11B/G/N Gateway

- VDSL2 pair bonding with Profiles 8a/b/c/d or 12a/b or 17a or ADSL2+ Pair Bonding
- VDSL2 single line with profiles 8a/b/c/d, 12a/b, 17a or 30a or ADSL2/2+
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- Supports IEEE 802.11b/g/n WiFi with 2-builtin transmitter and receiver antennae
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SKU: 6729-W1 Categories: Dasan Zhone Solutions, Modem Products, VDSL2, Customer Premise Equipment (CPE), Set-top Boxes (STB), Cable Modems, Data, Routers, Dasan Zhone Router, Wireless

(Source : https://www.multicominc.com/product/zhone-6729-w1-xdsl-bonding-4-port-802-11bgn-gateway/)

(Source : screenshot of PDF downloaded from https://fccid.io/PJZ67X9/Internal-Photos/Int-r1-2496944.pdf)

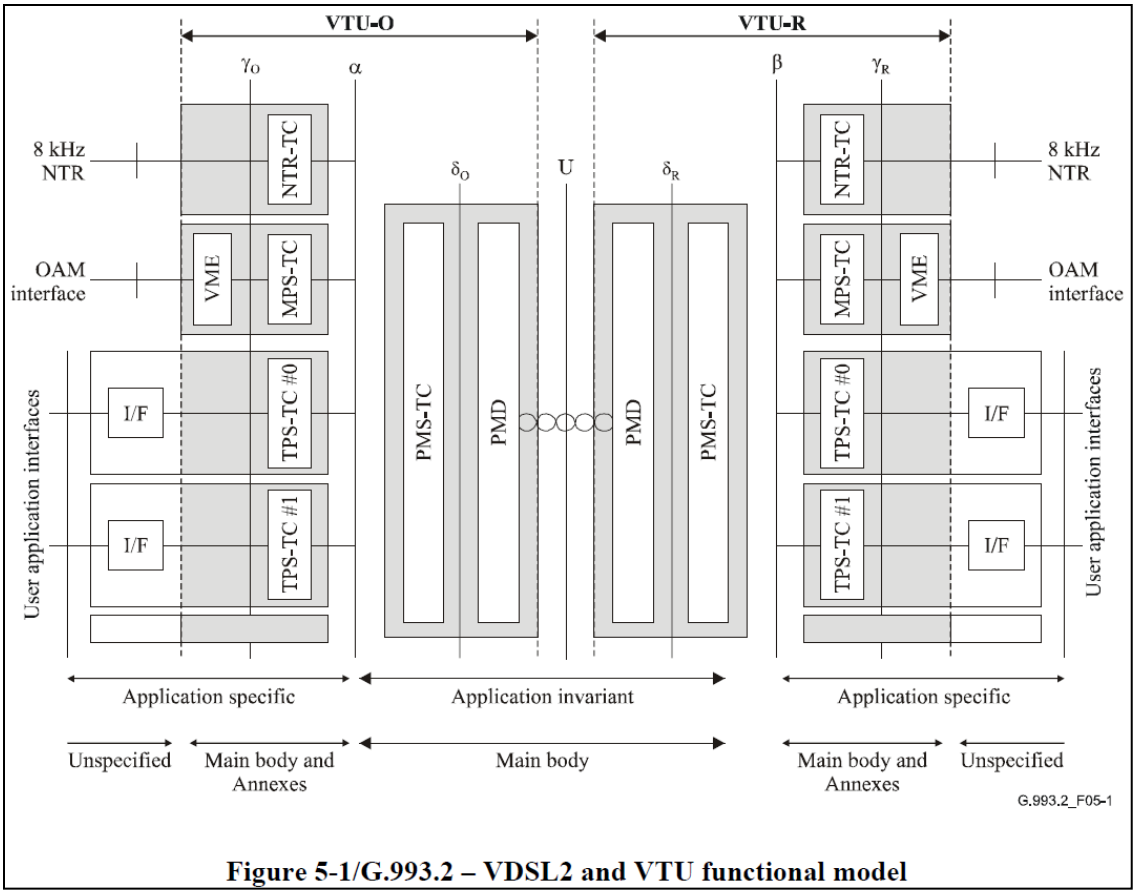

Figure 5-1/G.993.2 – VDSL2 and VTU functional model

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

8.1.1 User data TPS-TC types

There are three types of user data TPS-TCs defined in this Recommendation:

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- Type 3: Ethernet and generic packet transport (PTM-TC).

Each of these three types is defined as an application option. The VTU-O selects the user data TPS-TC type for each bearer channel, both upstream and downstream, based on the type of higher layer data it chooses to support on that bearer channel. The enabled user data TPS-TC type for each of the bearer channels is indicated during initialization.

Functionality, parameters, and application interface (γ interface) characteristics of the user data TPS-TCs supporting STM transport (STM-TC), ATM transport (ATM-TC), and ethernet and generic packet transport (PTM-TC) are specified in K.1, K.2 and K.3, respectively.

The transmit signals of the TPS-TC are submitted to the α/β interface. Signals passing via the α/β interface in both directions have an application-independent (transport protocol independent) format, as specified in 8.1.2. The particular bit rates for each of the multiplexed TPS-TCs at the α/β reference point are determined during system configuration.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

K.3 Packet transmission convergence function (PTM-TC)

K.3.1 Scope

The PTM-TC is intended for Ethernet transport and generic packet transport. The PTM-TC function provides procedures for the transport of one PTM-TC stream in either the upstream or downstream direction. Packet boundaries, octet boundaries, and the position of most significant bits are explicitly maintained across the transport for the PTM-TC stream. The PTM-TC stream is presented asynchronously across the γ_R or γ_O reference point with respect to the synchronization signals across the α/β interface.

The reference model, functionality, and γ interface of the PMS-TC are defined in Annex N/G.992.3 [10]. Referring to the reference model of Annex N/G.992.3 [10], the PTM-TC function of VDSL2 could be established over either of the enabled bearer channels.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

Annex N

64/65-octet PTM-TC sublayer functional specifications

N.1 Scope

The PTM-TC shall provide full transparent transfer of packets between the γ reference points at network and premises side (except non-correctable errors caused by the transmission medium). It shall also provide packet integrity and packet error monitoring capability.

In the transmit direction, the PTM-TC receives packets from the higher layer PTM entity via the γ-interface. An additional CRC is calculated on the packet and appended (to construct a PTM-TC frame). The PTM-TC then performs 64/65-octet encapsulation on the frame, and sends the resulting codewords to the PMS-TC via the α/β-interface. In the receive direction, the PTM-TC receives codewords from the PMS-TC via α/β-interface, recovers the transported PTM-TC frame, checks the CRC, and submits the extracted packet to the PTM entity via the γ-interface.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.992.3-200509-S!Amd1!PDF-E&type=items)

26. The methods practiced by Zhone's use of the accused products include encapsulating said previously stored Ethernet frames within a plurality of variable-length VDSL frames, wherein each Ethernet frame is encapsulated entirely within a respective variable-length

VDSL frame of the plurality of variable-length VDSL frames. For example, the Accused Products are used by Defendant to implement the ITU-T G.993.2 recommendation. The TPS-TC layers support transport of various types of user data. According to ITU-T G.993.2, ethernet packet is one of the user data types transported using Packet transmission convergence function (PTM-TC) function. The PTM-TC function provides procedures for transporting ethernet packets (frames) using PTM-TC frames (variable-length VDSL frames). Further, the PTM-TC function mentioned in the recommendation ITU-T G.993.2 is used for transporting an ethernet frame in a PTM-TC frame (variable-length VDSL frame) using VDSL transceiver unit (VTU). Also, the PTM-TC encapsulates the ethernet frames into PTM-TC frames (variable-length VDSL frames) by appending CRC to each ethernet frame.

K.3 Packet transmission convergence function (PTM-TC)

K.3.1 Scope

The PTM-TC is intended for Ethernet transport and generic packet transport. The PTM-TC function provides procedures for the transport of one PTM-TC stream in either the upstream or downstream direction. Packet boundaries, octet boundaries, and the position of most significant bits are explicitly maintained across the transport for the PTM-TC stream. The PTM-TC stream is presented asynchronously across the γ_R or γ_O reference point with respect to the synchronization signals across the α/β interface.

The reference model, functionality, and γ interface of the PMS-TC are defined in Annex N/G.992.3 [10]. Referring to the reference model of Annex N/G.992.3 [10], the PTM-TC function of VDSL2 could be established over either of the enabled bearer channels.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

K.3.8 Functionality

The functionality of the PTM-TC shall implement 64/65-octet encapsulation as defined in Annex N/G.992.3 [10], and shall include encapsulation, packet error monitoring, data rate decoupling, and frame delineation.

For frame error monitoring, the transmitting PTM-TC shall insert the 16-bit CRC defined in N.3.3/G.992.3 [10].

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

Annex N

64/65-octet PTM-TC sublayer functional specifications

N.1 Scope

The PTM-TC shall provide full transparent transfer of packets between the γ reference points at network and premises side (except non-correctable errors caused by the transmission medium). It shall also provide packet integrity and packet error monitoring capability.

In the transmit direction, the PTM-TC receives packets from the higher layer PTM entity via the γ-interface. An additional CRC is calculated on the packet and appended (to construct a PTM-TC frame). The PTM-TC then performs 64/65-octet encapsulation on the frame, and sends the resulting codewords to the PMS-TC via the α/β-interface. In the receive direction, the PTM-TC receives codewords from the PMS-TC via α/β-interface, recovers the transported PTM-TC frame, checks the CRC, and submits the extracted packet to the PTM entity via the γ-interface.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.992.3-200509-S!Amd1!PDF-E&type=items)

27. The methods practiced by Zhone's use of the accused products include wherein a first length of a first respective variable-length VDSL frame exceeds a second length of fixed-length VDSL frames. For example, the Accused Products are used by Defendant to implement the ITU-T G.993.2 recommendation. The Recommendation ITU-T G.993.2 includes VTU (VDSL2 transceiver unit) to transmit the user data using TPS-TC layers. The VTU further supports mapping of all TPS-TC types to all bearer channels that carry main data i.e. each VDSL link that transports user data supports multiple protocols. One such transport protocol is ATM-TC (VDSL protocol). ATM-TC protocol defines procedures for transporting ethernet frames that are encapsulated into ATM cells (VDSL frames) over VDSL links. Each ATM cell has a fixed length of 53 octets (fixed-length) and is transported over a fixed-length VDSL frame via VDSL link. Further, PTM-TC is also responsible to transport ethernet packets, which are variable in length, over variable-length VDSL frames. Further, the signals sent from the TPS-TC layer, either using ATM-TC or PTM-TC are converted into a unified format i.e., the signals from TPS-TC layer are application-independent in the subsequent layers of transmission. Ethernet packets,

generally, have a minimum of 64 data bytes. The PTM-TC is configured to encapsulate such ethernet packets into PTM-TC frames (corresponding frame) by appending CRC. The size of the variable-length PTM-TC (VDSL) frames therefore exceeds 53 octets (fixed length) defined in ATM-TC (VDSL frame). The PTM-TC frames are further mapped to transmission frame for transmission over VDSL link. Hence, the VTU is configured to transmit the PTM-TC frame (corresponding frame) on the VDSL link wherein the first length of a first respective variable-length VDSL frame exceeds a second length of fixed-length VDSL frames.

8.1.1 User data TPS-TC types

There are three types of user data TPS-TCs defined in this Recommendation:

- Type 1: STM transport (STM-TC);
- Type 2: ATM transport (ATM-TC); and
- Type 3: Ethernet and generic packet transport (PTM-TC).

Each of these three types is defined as an application option. The VTU-O selects the user data TPS-TC type for each bearer channel, both upstream and downstream, based on the type of higher layer data it chooses to support on that bearer channel. The enabled user data TPS-TC type for each of the bearer channels is indicated during initialization.

Functionality, parameters, and application interface (γ interface) characteristics of the user data TPS-TCs supporting STM transport (STM-TC), ATM transport (ATM-TC), and ethernet and generic packet transport (PTM-TC) are specified in K.1, K.2 and K.3, respectively.

The transmit signals of the TPS-TC are submitted to the α/β interface. Signals passing via the α/β interface in both directions have an application-independent (transport protocol independent) format, as specified in 8.1.2. The particular bit rates for each of the multiplexed TPS-TCs at the α/β reference point are determined during system configuration.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

VDSL	Very High Speed Digital Subscriber Line
VME	VDSL2 Management Entity
VTU	VDSL2 Transceiver Unit
VTU-O	VTU at the ONU (or central office, exchange, cabinet, etc., i.e., operator end of the loop)
VTU-R	VTU at the remote site (i.e., subscriber end of the loop)

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

A VTU shall support mapping of all supported TPS-TC types to all supported bearer channels, except that PTM on one bearer channel and ATM on the other bearer channel shall not be enabled simultaneously. The valid labelling of supported bearer channels shall start from 0 and increase by

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

ATM-TC

G.1 Scope

This annex specifies a VDSL ATM Transport Protocol Specific Transmission Convergence sublayer (ATM-TC), which describes the ATM based service transmission over a VDSL link. This annex defines a minimum set of requirements to deliver an ATM service from the ONU to the remote customer premises. It is based on the ITU-T Recs. I.432.x. The ATM-TC specification is applicable at both the VTU-O side and the VTU-R side.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.1-200111-S!!PDF-E&type=items)

G.4.1.1 Data flow

The Data flow consists of two streams of 53 octet ATM cells each (Tx_ATM, Rx_ATM) with independent rates flowing in opposite directions. Rate values are arbitrary under a predefined upper limit of aggregate channel capacity determined by the data rate at the corresponding α (or β) interface. The Data flow signal description is presented in Table G.1.

The ATM cell format is identical in both transmit and receive directions: 52 out of the 53 octets carry ATM layer data (user data). Octet number 5 is undefined (intended for HEC insertion in the TC sublayer).

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.1-200111-S!!PDF-E&type=items)

and I.2 and shown in Figure I.1. When a flow control flag is activated by the VTU-O (i.e. the VTU-O wants to transmit or receive a cell), the ATM layer initiates a cell Tx or cell Rx cycle (53 byte transfer). The VTU supports transfer of a complete cell within 53 consecutive clock cycles.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.1-200111-S!!PDF-E&type=items)

K.3 Packet transmission convergence function (PTM-TC)

K.3.1 Scope

The PTM-TC is intended for Ethernet transport and generic packet transport. The PTM-TC function provides procedures for the transport of one PTM-TC stream in either the upstream or downstream direction. Packet boundaries, octet boundaries, and the position of most significant bits are explicitly maintained across the transport for the PTM-TC stream. The PTM-TC stream is presented asynchronously across the γ_R or γ_O reference point with respect to the synchronization signals across the α/β interface.

The reference model, functionality, and γ interface of the PMS-TC are defined in Annex N/G.992.3 [10]. Referring to the reference model of Annex N/G.992.3 [10], the PTM-TC function of VDSL2 could be established over either of the enabled bearer channels.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

K.3.8 Functionality

The functionality of the PTM-TC shall implement 64/65-octet encapsulation as defined in Annex N/G.992.3 [10], and shall include encapsulation, packet error monitoring, data rate decoupling, and frame delineation.

For frame error monitoring, the transmitting PTM-TC shall insert the 16-bit CRC defined in N.3.3/G.992.3 [10].

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

Annex N

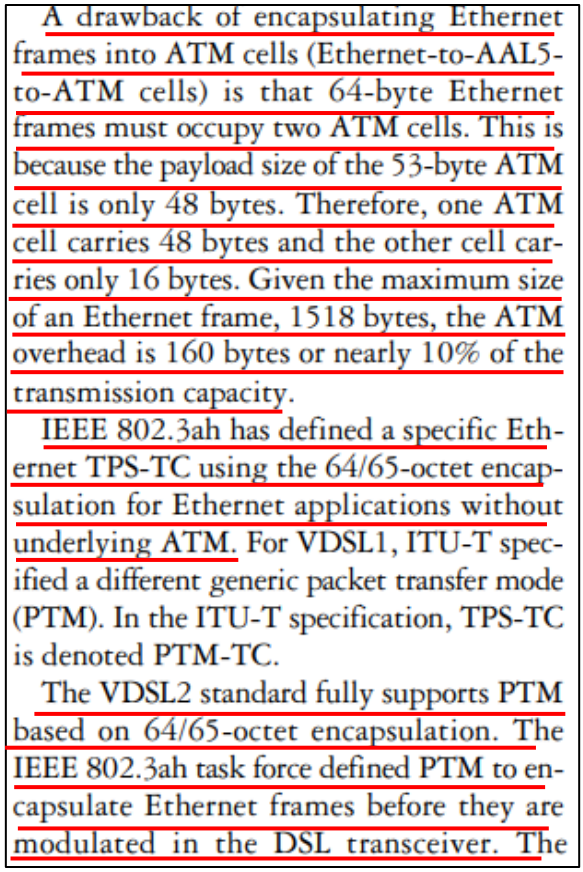
64/65-octet PTM-TC sublayer functional specifications

N.1 Scope

The PTM-TC shall provide full transparent transfer of packets between the γ reference points at network and premises side (except non-correctable errors caused by the transmission medium). It shall also provide packet integrity and packet error monitoring capability.

In the transmit direction, the PTM-TC receives packets from the higher layer PTM entity via the γ-interface. An additional CRC is calculated on the packet and appended (to construct a PTM-TC frame). The PTM-TC then performs 64/65-octet encapsulation on the frame, and sends the resulting codewords to the PMS-TC via the α/β-interface. In the receive direction, the PTM-TC receives codewords from the PMS-TC via α/β-interface, recovers the transported PTM-TC frame, checks the CRC, and submits the extracted packet to the PTM entity via the γ-interface.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.992.3-200509-S!Amd1!PDF-E&type=items)



A drawback of encapsulating Ethernet frames into ATM cells (Ethernet-to-AAL5-to-ATM cells) is that 64-byte Ethernet frames must occupy two ATM cells. This is because the payload size of the 53-byte ATM cell is only 48 bytes. Therefore, one ATM cell carries 48 bytes and the other cell carries only 16 bytes. Given the maximum size of an Ethernet frame, 1518 bytes, the ATM overhead is 160 bytes or nearly 10% of the transmission capacity.

IEEE 802.3ah has defined a specific Ethernet TPS-TC using the 64/65-octet encapsulation for Ethernet applications without underlying ATM. For VDSL1, ITU-T specified a different generic packet transfer mode (PTM). In the ITU-T specification, TPS-TC is denoted PTM-TC.

The VDSL2 standard fully supports PTM based on 64/65-octet encapsulation. The IEEE 802.3ah task force defined PTM to encapsulate Ethernet frames before they are modulated in the DSL transceiver. The

(Source: http://www.hit.bme.hu/~jakab/edu/litr/Access/DSL/vdsl2.pdf)

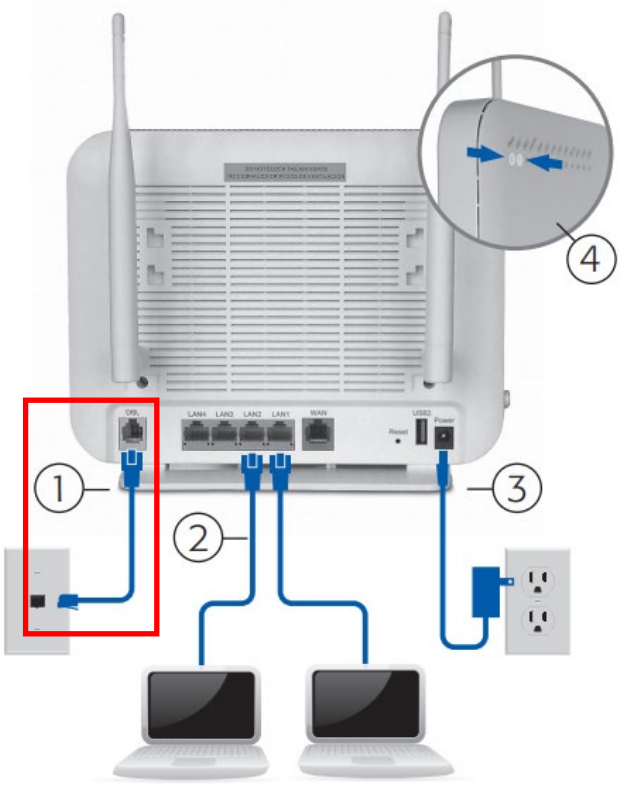
28. The methods practiced by Zhone's use of the accused products include transmitting said plurality of variable-length VDSL frames over said VDSL facility. For example, the Accused Products are used by Defendant to implement the ITU-T G.993.2 recommendation. The Recommendation specified by ITU-T G.993.2 includes a VTU (VDSL2 Transceiver Unit) functional model that encapsulates and transmits ethernet packets using very a high-speed digital subscriber line (VDSL) link. The model includes an application specific layer comprising Transport Protocol Specific - Transmission Convergence (TPS-TC) sub-layers. The TPS-TC layers support transport of packets using ATM-TC (Asynchronous Transfer Mode – Transmission Convergence). Also, the ITU-T G.993.2 standard recommends transfer of ethernet packets using PTM-TC (Packet Transfer Mode – Transmission Convergence). Further, the

signals sent from the TPS-TC layer, either using ATM-TC or PTM-TC are converted into a unified format i.e., the signals from TPS-TC layer are application-independent in the subsequent layers of transmission. The variable-length VDSL frame are thus transmitted over said VDSL facility.

VDSL2-6712-W1

Category: CPE

(Source : https://dzsi.com/product/vdsl2-6712-w1/)



(Source : https://www.consolidated.com/Portals/0/Support/Residential Support/High-Speed Internet/Internet Installation and Modem Guides/ZhoneConfig/Zhone 6729 Install Guide.pdf)

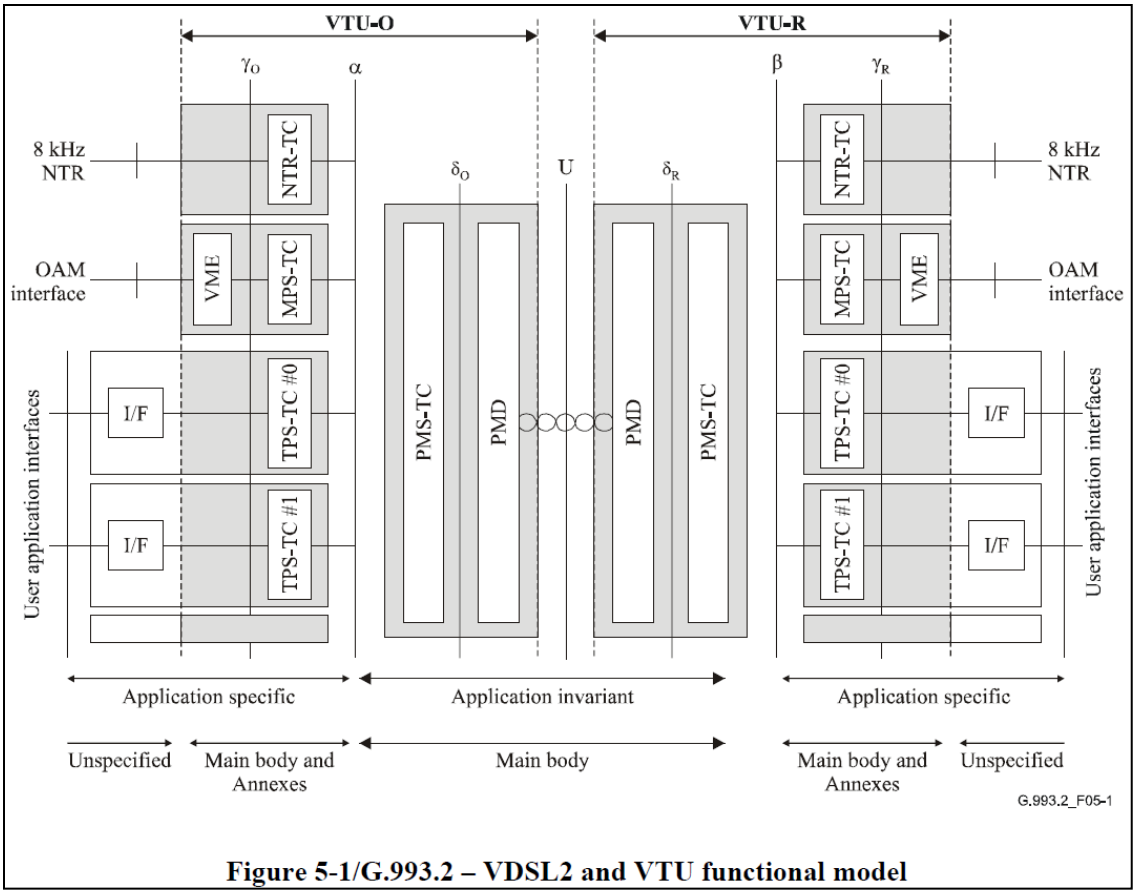


Figure 5-1/G.993.2 – VDSL2 and VTU functional model

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

8.1.1 User data TPS-TC types

There are three types of user data TPS-TCs defined in this Recommendation:

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- Type 3: Ethernet and generic packet transport (PTM-TC).

Each of these three types is defined as an application option. The VTU-O selects the user data TPS-TC type for each bearer channel, both upstream and downstream, based on the type of higher layer data it chooses to support on that bearer channel. The enabled user data TPS-TC type for each of the bearer channels is indicated during initialization.

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(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

K.3 Packet transmission convergence function (PTM-TC)

K.3.1 Scope

The PTM-TC is intended for Ethernet transport and generic packet transport. The PTM-TC function provides procedures for the transport of one PTM-TC stream in either the upstream or downstream direction. Packet boundaries, octet boundaries, and the position of most significant bits are explicitly maintained across the transport for the PTM-TC stream. The PTM-TC stream is presented asynchronously across the γ_R or γ_O reference point with respect to the synchronization signals across the α/β interface.

The reference model, functionality, and γ interface of the PMS-TC are defined in Annex N/G.992.3 [10]. Referring to the reference model of Annex N/G.992.3 [10], the PTM-TC function of VDSL2 could be established over either of the enabled bearer channels.

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

VDSL	Very High Speed Digital Subscriber Line
VME	VDSL2 Management Entity
VTU	VDSL2 Transceiver Unit
VTU-O	VTU at the ONU (or central office, exchange, cabinet, etc., i.e., operator end of the loop)
VTU-R	VTU at the remote site (i.e., subscriber end of the loop)

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

> A VTU shall support mapping of all supported TPS-TC types to all supported bearer channels, except that PTM on one bearer channel and ATM on the other bearer channel shall not be enabled simultaneously. The valid labelling of supported bearer channels shall start from 0 and increase by

(Source: https://www.itu.int/rec/dologin_pub.asp?lang=e&id=T-REC-G.993.2-200602-S!!PDF-E&type=items)

29. Far North Patents has been damaged as a result of the infringing conduct by Zhone alleged above. Thus, Zhone is liable to Far North 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.

30. Far North Patents and/or its predecessors-in-interest have satisfied all statutory obligations required to collect pre-filing damages for the full period allowed by law for infringement of the '985 Patent.

ADDITIONAL ALLEGATIONS REGARDING INFRINGEMENT

31. In addition to any specific products mentioned above, the accused products also include at least the following products: Zhone 6618-W1, Zhone VDSL2-6712-W1, Zhone 6718-W1, Zhone 6728-W1, Zhone 6729-W1, Zhone 6748-W1, and Zhone 6768-W1.

32. Zhone has also indirectly infringed the '707 Patent and the '985 Patent by inducing others to directly infringe the '707 Patent and the '985 Patent. Zhone has induced the

end-users, Zhone's customers, to directly infringe (literally and/or under the doctrine of equivalents) the '707 Patent and the '985 Patent by using the accused products.

33. Zhone 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 patents-in-suit, including, for example, Claim 1 of the '707 Patent and Claim 1 of the '985 Patent.

34. Such steps by Zhone included, among other things, advising or directing customers and end-users 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.

35. Zhone has performed these steps, which constitute induced infringement, with the knowledge of the '707 Patent and the '985 Patent and with the knowledge that the induced acts constitute infringement.

36. Zhone was and is aware that the normal and customary use of the accused products by Zhone's customers would infringe the '707 Patent and the '985 Patent. Zhone's inducement is ongoing.

37. Zhone 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 '707 Patent and the '985 Patent by importing, selling, offering to sell, and/or using the accused products.

38. Zhone has at least a significant role in placing the accused products in the stream of commerce in Texas and elsewhere in the United States.

39. Zhone 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.

40. Zhone directs or controls the sale of the accused products into established United States distribution channels, including sales to nationwide retailers.

41. Zhone's established United States distribution channels include one or more United States based affiliates (including, for example, Zhone Technologies, Inc.).

42. Zhone directs or controls the sale of the accused products online as well as through nationwide service providers, including for sale in Texas and elsewhere in the United States, and expects and intends that the accused products will be so sold.

43. Zhone 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 patents-in-suit, including, for example, Claim 1 of the '707 Patent and Claim 1 of the '985 Patent.

44. Such steps by Zhone 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 their behalf, to import, sell, or offer to sell the accused products in an infringing manner.

45. Zhone performed these steps, which constitute induced infringement, with the knowledge of the '707 Patent and the '985 Patent and with the knowledge that the induced acts would constitute infringement.

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

47. Zhone's inducement is ongoing.

48. Zhone has also indirectly infringed by contributing to the infringement of the '707 Patent and the '985 Patent. Zhone has contributed to the direct infringement of the '707 Patent and the '985 Patent by the end-user of the accused products.

49. 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 '707 Patent and the '985 Patent, including, for example, Claim 1 of the '707 Patent and Claim 1 of the '985 Patent.

50. The special features include improved VDSL2 transmission capabilities used in a manner that infringes the '707 Patent and the '985 Patent.

51. The special features constitute a material part of the invention of one or more of the claims of the '707 Patent and the '985 Patent and are not staple articles of commerce suitable for substantial non-infringing use.

52. Zhone's contributory infringement is ongoing.

53. Furthermore, Zhone 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 Far North Patents' patent rights. *See, e.g.*, M. Lemley, "Ignoring Patents," 2008 Mich. St. L. Rev. 19 (2008).

54. Zhone'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 Zhone.

55. Zhone has knowledge of the '707 Patent and the '985 Patent.

56. Zhone's customers have infringed the '707 Patent and the '985 Patent.

57. Zhone encouraged its customers' infringement.

58. Zhone's direct and indirect infringement of the '707 Patent and the '985 Patent is, has been, and/or continues to be willful, intentional, deliberate, and/or in conscious disregard of Far North Patents' rights under the patents.

59. Far North Patents has been damaged as a result of the infringing conduct by Zhone alleged above. Thus, Zhone is liable to Far North 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

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

PRAYER FOR RELIEF

Far North Patents requests that the Court find in its favor and against Zhone, and that the Court grant Far North Patents the following relief:

a. Judgment that one or more claims of the '707 Patent and the '985 Patent have been infringed, either literally and/or under the doctrine of equivalents, by Zhone and/or all others acting in concert therewith;

b. A permanent injunction enjoining Zhone and its officers, directors, agents, servants, affiliates, employees, divisions, branches, subsidiaries, parents, and all others acting in concert therewith from infringement of the '707 Patent; or, in the alternative, an award of a reasonable ongoing royalty for future infringement of the '707 Patent by such entities;

c. Judgment that Zhone account for and pay to Far North Patents all damages to and costs incurred by Far North Patents because of Zhone's infringing activities and other conduct

complained of herein, including an award of all increased damages to which Far North Patents is entitled under 35 U.S.C. § 284;

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

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

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

Dated: October 23, 2020

Respectfully submitted,

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