AN5116-06B

Optical Line Terminal Equipment

Product Description

Version: C

Code: MN000000066

FiberHome Telecommunication Technologies Co., Ltd.

February 2012

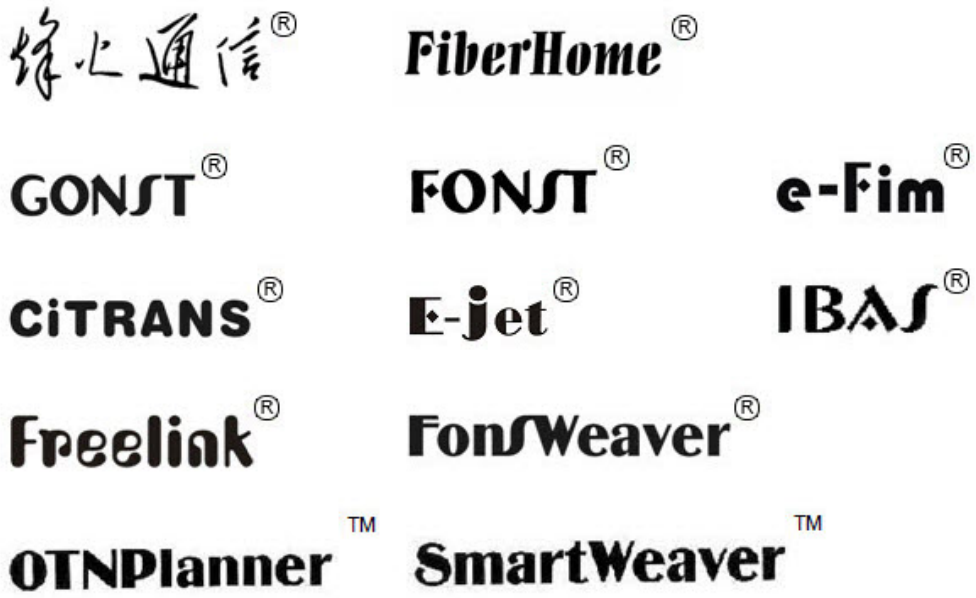
Thank you for choosing our products.

We appreciate your business. Your satisfaction is our goal. We will provide you with comprehensive technical support and after-sales service. Please contact your local sales representative, service representative or distributor for any help needed at the contact information shown below.

Fiberhome Telecommunication Technologies Co., Ltd.

Address: No.5 Dongxin Rd., Hongshan Dist., Wuhan, China
Zip code: 430073
Tel: +86 27 8769 1549
Fax: +86 27 8769 1755
Website: http://www.fiberhomegroup.com

Legal Notice



are trademarks of FiberHome Telecommunication Technologies Co., Ltd. (Hereinafer referred to as FiberHome)

All brand names and product names used in this document are used for identification purposes only and are trademarks or registered trademarks of their respective holders.

Preface

Related Documentation

Document	Description
AN5116-06B Optical Line Terminal Equipment Documentation Guide	Introduces the retrieval method, contents, releasing, reading approach, and suggestion feedback method for the complete manual set for the AN5116-06B.
AN5116-06B Optical Line Terminal Equipment Product Description	Introduces the AN5116-06B's network location, functional features, hardware structure, FTTx application model, equipment configuration, network management system and technical specifications. It is the foundation of the complete manual set. Other manuals extend and enrich the concepts introduced in the Product Description.
AN5116-06B Optical Line Terminal Equipment Feature Description	Introduces the key features supported by the AN5116-06B, including GPON / EPON access, GPON / EPON terminal management, VLAN, multicast, voice and safety; and introduces these functions in details in terms of definition, features, specification, principle description, references and so on.
AN5116-06B Optical Line Terminal Equipment Hardware Description	Introduces the appearance, structure, functions, technical specifications, and operating method for the AN5116-06B's cabinet, PDP, subrack, cards, cables and wires, facilitating users' mastery of the hardware features of the equipment.
AN5116-06B Optical Line Terminal Equipment Installation Guide	Introduces the overall installation and acceptance inspection procedures from unpacking inspection to power-on examination after the equipment is delivered on site, and provides reference information (e.g. safety principles and wiring scheme of various interfaces) to guide users to install the equipment.
AN5116-06B Optical Line Terminal Equipment EPON Configuration Guide	Introduces the method for configuring the EPON services supported by the AN5116-06B via the ANM2000, such as basic configuration, voice service configuration, data service configuration, multicast service configuration, and software upgrading configuration, to guide users on start-up for various services and software upgrading.

Document	Description
AN5116-06B Optical Line Terminal Equipment GPON Configuration Guide	Introduces the method for configuring the GPON services supported by the AN5116-06B via the ANM2000, such as basic configuration, voice service configuration, data service configuration, multicast service configuration, and software upgrading configuration, to guide users on start-up for various services and software upgrading.
AN5116-06B Optical Line Terminal Equipment GUI Reference	Introduces the shortcut menu for every card of the AN5116-06B on the ANM2000, including the function, parameter explanation, precautions and configuration example of every command in the shortcut menu of each card, to help users master the operation of the AN5116-06B using the ANM2000.
AN5116-06B Optical Line Terminal Equipment Component Replacement	Introduces the operation procedures for replacing the AN5116-06B's components, including preparations, precautions, early operations, operation process and subsequent operations, so as to guide users with the component replacement on the hardware.
AN5116-06B Optical Line Terminal Equipment Routine Maintenance	Introduces the daily, weekly, monthly, quarterly and annual routine maintenance operations on the AN5116-06B. Users are able to eliminate silent failures in the equipment operation process as early as possible via implementing the routine maintenance.
AN5116-06B Optical Line Terminal Equipment Alarm and Event Reference	Introduces the AN5116-06B's alarm / event information, including alarm / event names, alarm / event levels, possible reasons, effects on the system, and processing procedures, to guide users on effective alarm / event processing.
AN5116-06B Optical Line Terminal Equipment Troubleshooting Guide	Introduces the fault processing principles and methods of fault diagnosis and isolation for the AN5116-06B. Also discusses the typical fault cases of various EPON / GPON services. In case of complex issues, users can contact FiberHome for technical support according to the instructions in this document.

Version

Version	Description
A	This manual corresponds to the AN5116-06B EPON V1.0. Initial version
B	This manual corresponds to the AN5116-06B EPON V1.0 and GPON V1.0. Information about the GC4B and GU6F cards is added, GPON access function is introduced, and the content and networking diagrams are optimized in Version B on the basis of Version A.
C	This manual corresponds to the AN5116-06B EPON V3.1 and GPON V3.1. Information about the EC8B card, GC8B card and XG2B card is added, and the content and networking diagrams are optimized in Version C on the basis of Version B.

This manual mainly introduces the functions, features, application models, network management systems and technical specifications of the AN5116-06B, so that users can obtain technical support from a better understanding of technologies, performance, operations of the equipment.

Intended Readers

This manual is intended for the following readers:

- Marketing personnel
- Commissioning engineers
- Equipment maintenance staff

To utilize this manual, these prerequisite skills are necessary:

- EPON technology
- GPON technology
- Multicast technology
- NGN voice technology
- Ethernet switch technology
- Computer network technology

Conventions

Terminology Conventions

Terminology	Convention
AN5116-06B	The AN5116-06B Optical Line Terminal Equipment
EC4B	4×EPON-C Interface Card (type B)
EC8B	8×EPON-C Interface Card (type B)
GC4B	4×GPON-C Interface Card (type B)
GC8B	8×GPON-C Interface Card (type B)
XG2B	2×10G EPON-C Interface Card (type B)
C155A	4×GE + 1×10GE Optical Interface Uplink Card (CES Mode)
CE1B	32×E1 Optical Interface Card (CES mode) (type B)
PUBA	Public Card (type A)
HSWA	Core Switch Card (EPON) (card No.: 2.115.334)
	Core Switch Card (type A) (card No.: 2.115.331)
HU1A	4×GE + 1×10GE Optical Interface Uplink Card
HU2A	2×GE + +2×10GE Optical Interface Uplink Card
GU6F	6×GE Optical Interface Uplink Card

Symbol Conventions

Symbol	Convention	Description
	Note	Important features or operation guide.
	Caution	Possible injury to persons or systems, or cause traffic interruption or loss.
	Warning	May cause severe bodily injuries.
➔	Jump	Jumps to another step.
→	Cascading menu	Connects multi-level menu options.
↔	Bidirectional service	The service signal is bidirectional.
→	Unidirectional service	The service signal is unidirectional.

Text Conventions

Symbol	Convention	Description
/	**or**	HU1A/HU2A indicates the HU1A card or the HU2A card.
+	**and**	SP+WRR indicates the strict priority and the weighted round robin scheduling algorithms.

Contents

Figures

Tables

1 Product Introduction

This chapter introduces the AN5116-06B's application, functions and features.

☑ Product Positioning

☑ Functions and Features

☑ List of Functional Features

1.1 Product Positioning

The AN5116-06B is a new intelligent carrier-class EPON / GPON integrated access product offered by FiberHome.

Functional positioning

The AN5116-06B's functional positioning is as follows:

- Used together with remote end ONUs (Optical Network Unit) as office end OLTs (Optical Line Terminal) in the EPON / GPON system.
- Supports integrated broadband / narrowband services, such as VoIP, TDM, data, IPTV, CATV.
- Converges Layer 2 and Layer 3 data.

Network positioning

See Figure 1-1 for the network positioning of the AN5116–06B.

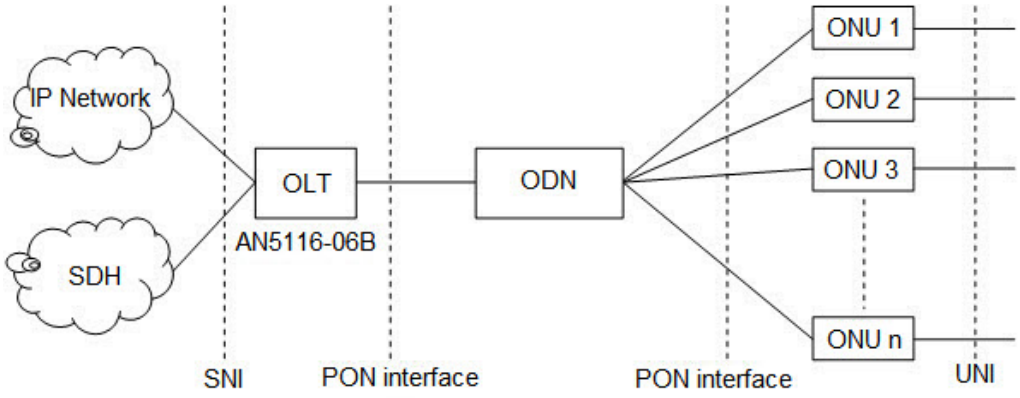


Figure 1-1 The AN5116-06B's position in the network

As shown in Figure 1-1, the AN5116-06B is usually placed in the equipment room of residential community or central office. The network positioning of the AN5116-06B is as follows:

- On the network side, the AN5116-06B provides GE or 10GE uplink port(s) for connecting to a BMAN (Broadband Metro Area Network) via BRAS (Broadband Remote Access Server). It also provides an STM-1 optical interface or E1 electrical interface for connecting to SDH (Synchronous Digital Hierarchy) equipment or traditional PDH (Plesynchronous Digital Hierarchy) equipment.
- On user side, the AN5116-06B provides users with various services incorporated in a single fiber, such as voice, data and audio services, via an ODN (Optical Distribution Network), so as to cater for users' individualized demands.

1.2 Functions and Features

This section introduces the functions and features of the AN5116-06B.

1.2.1 EPON / GPON Integrated Access Capability

The AN5116-06B is EPON / GPON integrated access equipment that can simultaneously support both EPON and GPON services, so as to overcome the restrictions on access to bandwidth and cater to subscribers' demands for high bandwidth services.

EPON access capability

- Supports all the EPON functions defined in IEEE 802.3-2008 standard.
- Supports extended OAM function.
- Supports various kinds of ONUs, such as SFU, cassette MDU (including LAN type and xDSL type), shelf-based MDU and HGU ONU.
- Provides EPON transmission with large bandwidth capacity:
  - Downlink rate: 1.25 Gbit/s and 2.5 Gbit/s
  - Uplink rate: 1.25 Gbit/s
- Supports DBA (Dynamic Bandwidth Allocation) algorithm:
  - The minimum configurable bandwidth of the DBA is no more than 256 Kbit/s.

- The minimum bandwidth allocation granularity of the DBA is in steps of 64 Kbit/s.
- The accuracy of the DBA is better than ±5%.

- Supports long-distance transmission. The long-distance coverage problem of twisted pair cable access technology is solved. The maximum transmission distance (PON+ twisted pair cable) can be more than 20 km.
- Provides a high split ratio of 1:64 by using PON technology, so as to improve capacity, conserve fiber consumption, and facilitate network reach.

10G EPON access capability

- Supports the 10G EPON functions defined in IEEE 802.3av standard.
- Supports various kinds of ONUs, such as SFU, cassette MDU (including LAN type and xDSL type), shelf-based MDU and HGU ONU.
- Provides transmission with large bandwidth capacity:
  - Uplink rate: 10 Gbit/s and 1.25 Gbit/s
  - Downlink rate: 10 Gbit/s
- Supports the DBA algorithm for uplink bandwidth allocation, and supports three bandwidth types: the fixed bandwidth, assured bandwidth, and best effort bandwidth.
- Provides a high split ratio of 1:64, and can reach 1:128 if optical power permits, which improves capacity, conserves fiber consumption, and facilitates network reach.
- Supports transmission distance up to 20km for the split ratio of 1:64, and larger distance for a lower split ratio.

GPON access capability

- Conforms to ITU-T G.984 serial standards, with good interoperability.
- Supports extended OAM function.
- Supports various kinds of ONUs, such as SFU, SBU, cassette MDU (including LAN type and xDSL type), shelf-based MDU and HGU ONU.
- Provides GPON transmission with large bandwidth capacity:
  - Downlink rate: 2.5 Gbit/s

- Uplink rate: 1.25 Gbit/s

- Supports both SBA (Static Bandwidth Allocation) and DBA algorithms:
  - SBA ensures a fixed bandwidth for each ONU.
  - DBA allocates bandwidth according to subscriber's traffic dynamically.
  - The minimum configurable bandwidth of the DBA is 256 Kbit/s.
  - The bandwidth allocation granularity of the SBA and DBA is in steps of 64 Kbit/s;.
  - The accuracy of the DBA is better than ±5%.
- Supports long-distance transmission.
  - By using PON technology, the long-distance coverage problem of twisted pair cable access technology is solved.
  - Supports uplink and downlink FEC (Forward Error Correction) to improve bit error ratio.
  - The maximum transmission distance (PON + twisted pair cable) can be more than 20 km.
- Provides a high split ratio of 1:64, and can reach 1:128 if optical power permits, which improves capacity, conserves fiber consumption, and facilitates network reach.
- Supports data transmission in an efficient way.
  - Encapsulates all the data to be transmitted into 125us frames (fixed length frames) via the new GEM (GPON Encapsulation Mode) encapsulation protocol. In this way, a smaller number of transmission overhead bytes are used, and the transmission efficiency is enhanced.
  - The transmission efficiency can reach up to 93% when the downlink rate is 2.5Gbit/s and the uplink rate is 1.25Gbit/s.

1.2.2 Interface Types

The AN5116-06B provides a variety of physical interface types, as shown in Figure 1-2.

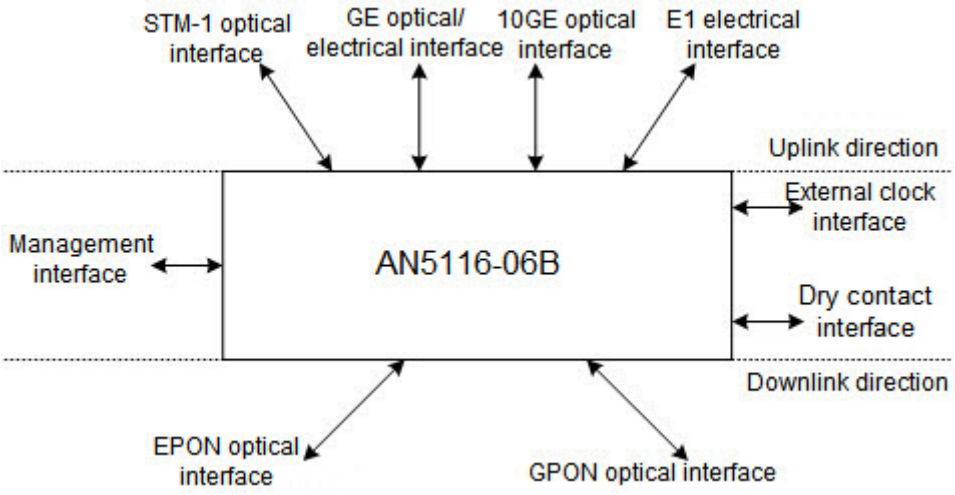


Figure 1-2 Physical interfaces of the AN5116-06B

The functions of the AN5116-06B's interfaces are shown in Table 1-1.

Table 1-1 Interfaces of the AN5116-06B

Class	Type	Function
Uplink interface	10GE optical interface	Provides 10GE Ethernet uplink optical interface.
	GE optical interface	Provides GE Ethernet uplink optical interface.
	GE electrical interface	Provides GE Ethernet uplink electrical interface.
	STM-1 optical interface	Provides connection to STM-1 optical interface of transmission equipment.
	E1 electrical interface	Provides connection to E1 interface of transmission equipment.
Subscriber interface	EPON optical interface	Provides EPON subscriber interface.
	GPON optical interface	Provides GPON subscriber interface.
Management interface	FE interface	Supports out-of-band GUI management.
	10 GE / GE interface	Supports in-band GUI management.
Management interface	RJ-45 interface (using RS-232 interface protocol)	Supports out-of-band local CLI management.
Dry contact interface	RJ-45 interface	Enables collection of external environment variables that can be reported to the network management system.

Table 1-1 Interfaces of the AN5116-06B (Continued)

Class	Type	Function
External clock interface	Clock coaxial interface	Provides input and output of E1 external clock and BITS clock.
Alarming interface	RJ-45 interface	Transports subrack alarm signals to the PDP.

1.2.3 Flexible Solution

- Supports Triple-play.

  The FTTx system uses WDM technology to incorporate CATV signals and users' data and voice services, transmitting through a single fiber by placing a passive optical multiplexer outside the AN5116-06B, to achieve Triple-play function.

- Supports FTTH application.

  The AN5116-06B uses FTTH to provide voice, data, and video services through a single fiber to provide services to the relatively decentralized suburban environment.

- Supports refurbishment / replacement of antiquated copper plant.

  The AN5116-06B's service interface card provides EPON / GPON interfaces. When the AN5116-06B is used together with the AN5006-07 / 09 / 10 and the AN5506–07 / 09 / 10, it can guarantee access of voice, data and multicast services by introducing optical feeds to the existent copper LAN network via FTTB.

- Supports delivery of broadband services to both rural and urban neighborhoods.

  The AN5116-06B's service interface card provides EPON / GPON interfaces. When the AN5116-06B is used together with the AN5006-20, it can provide high bandwidth, and ensure access of voice and data services. Through Fiber + xDSL, it also can adapt to the access condition of densely populated areas, and fully meet current and future communication requirements of rural subscribers.

- Supports mobile base station traffic transmission.

The AN5116-06B provides two kinds of TDM interface cards that provide E1 electrical interfaces and STM-1 optical uplink interfaces respectively. When they are used together with the AN5006-06A / AN5506-06A or the AN5006-20 (equipped with the TDM card), the TDM signal of mobile base station can be uplinked to the transmission equipment to achieve TDM emulation function.

1.2.4 Multicast Functions

The user side and network side interfaces of the AN5116-06B support IGMP (Internet Group Management Protocol) V2 / V3. Incorporating the P2MP (Point to Multiple Point) feature of PON, the AN5116-06B is able to provide a sound multicast solution for subscribers.

Supporting multicast functions:

- Supports IGMP V2 / V3 protocol.
- Supports IGMP Proxy protocol and IGMP Snooping protocols.
- Each subrack supports up to 4000 concurrent multicast groups.
- Supports prejoin function which enables joining pre-configured multicast group by automatically sending joining message uplink.
- Supports preview function.
- Supports fast leave function.
- Supports cascade of multicast services accessed in EPON / GPON mode.
- Supports cross-VLAN multicast.
- Supports management and identification of subscribers and program sources based on multicast VLAN.
- Supports management of multicast group members via IGMP Proxy and IGMP Snooping messages.
- Supports dynamic management of joining / leaving and maintaining of multicast members via IGMP Report / Leave and Query messages.
- Multicast statistics supported: count of subscriber joining / leaving multicast group, total duration of watching and average duration of watching for each multicast group.

- Supports online query of multicast information: ability to query the core switch card, line card and online multicast groups, members and status of ONU hierarchically.
- Multicast service CDR (Call Detail Record) function: including subscriber port information, address of multicast group, joining and leaving time, leaving pattern (forcibly or freely), and authority information.
- Supports controllable multicast function, and provides multicast subscriber-based control, including information display, log and statistics of subscriber joining / leaving multicast group events, which can effectively prevent protocol attack, illegal multicast sources, illegal rebroadcasting, and illegal receiver to guarantee operators' revenue.

Multicast routing function supported

- Supports the PIM-SM / DM protocol.
- The AN5116-06B can enable the PIM protocol and connect the user side multicast router and network side multicast router via the OLT uplink interface.
- The AN5116-06B can enable the PIM protocol, so that it can work cooperatively with Layer 2 IGMP multicast protocol.
  - In case that the multicast router does not support the IGMP protocol, the uplink port of the AN5116-06B will enable the PIM protocol and connect to the PIM router to set up the multicast route.
  - If the multicast router supports the IGMP, the AN5116-06B will provide multicast services to subscribers under the OLT via Layer 2 IGMP functions.
- Supports PIM transparent transmission: the AN5116-06B can enable the PIM transparent transmission to achieve transparent transmission for OLT network side PIM router and the ONU side PIM router.

1.2.5 NGN Voice Functions

The AN5116-06B supports using H.248 (Megaco/H.248 Media Gateway Control protocol), MGCP (Media Gateway Control protocol) and SIP (Session Initiation Protocol) to achieve NGN voice functions. It uses the ONU to process NGN voice signals, and uses a softswitch or IMS to perform call control, which provides VoIP access for analog subscribers, meeting the requirements of carrier-class speech quality, management and operation.

Achieving NGN voice services

- Supports ITU-T H.248, MGCP and SIP protocols to a softswitch to achieve NGN services.
- Supports SIP protocol to an IMS to achieve NGN services.

NGN voice functions supported

- Provides analogue line testing function for POTS interfaces.
- Supports multi-MGC list.
- VLAN of each voice channel supports IEEE 802.1Q and PRI setting.
- Supports QinQ encapsulation for voice services.
- Call processing capability is 25k BHCA.
- Percent of call completed is larger than 99.999%.
- Supports IP phone access for POTS subscribers.
- Supports T.30 / T.38-based FoIP (Fax over IP).
- Supports transparent transportation of MoIP.
- Supports pulse accounting and polarity-reversal accounting.
- Supports IP CENTERX service.
- Supports the following intelligent services and user-defined services when assisted by the softswitch:
  - Calling number identification (CNID) presentation and restriction.
  - Call waiting.
  - Three party service.

- Alarm clock service.
- Call forwarding (unconditional, busy and no answer).
- Immediate hotline.
- Outgoing call blocking.
- Distinctive ring.

1.2.6 TDM Emulation Functions

The AN5116-06B provides TDM emulation functions based on RFC 5086 (CESoPSN), and can provide subscribers with multiple TDM services such as mobile base station backhauling and E1 private line.

Realization of TDM services

The AN5116-06B is equipped with the CE1B card and C155A card which respectively provide the E1 electrical interface and STM-1 optical interface for uplink connection of TDM services. The AN5116-06B has a CES protocol processor built in to translate between TDM format and Ethernet packet format.

- Uplink direction: accesses TDM emulation packets from the ONU side via the EPON / GPON service card, and after the packets are processed by the core switch card, delivers them to the CE1B / C155A card for protocol translation and transforms them into E1 or STM-1 format to continue uplink to the SDH network via the E1 or STM-1 uplink interface.
- Downlink direction: the CE1B / C155A card transforms E1 / STM-1 TDM traffic from the SDH network via the E1 or STM-1 uplink interface into Ethernet packets and distributes them to the ONUs via the EPON / GPON service card. The ONUs then restore the original TDM traffic flow.

TDM emulation functions supported

- Supports the TDM service using CESoPSN.
- Supports asynchronous clock mode and synchronous clock mode.
- Supports network management selection of the clock types: local oscillator, external clock 1, external clock 2, clock extracted from E1 line, and clock extracted from STM-1 optical line.

- Supports network management selection of the ONU clock recovery mode: adaptive clock, enhanced clock, differential clock and loopback clock.
- Supports two uplink interfaces: STM-1 interface and E1 interface.

1.2.7 Flexible Layer 3 Routing Function

Supporting OSPF routing

- Supports the OSPF (Open Shortest Path First) protocol.
- Supports fast convergence: sends updated messages immediately when the network topology structure changes to enable synchronization in the autonomous system.
- Supports equal-cost multipath routing: provides multiple equal-cost routes leading to the same destination.
- Supports message authentication: provides interface-based message authentication, so as to ensure the security of route calculation.
- Supports multicast address.

Supporting RIP routing function

- Supports RIP1 and RIP2 routing protocols.
- Supports external route tags: performs flexible control of routes according to route tags in the routing policy.
- Supports authentication of protocol messages: provides two authentication modes, i.e., PAP-based clear-test authentication and MD5 authentication, so as to enhance the system security.
- Supports two message transmission modes: broadcast and multicast.

1.2.8 Flexible VLAN Function

The AN5116-06B provides powerful VLAN stacking and VLAN translation functions, and can manage various subscribers' services effectively to enhance the network security.

QinQ VLAN / VLAN stacking functions supported

VLAN (Virtual Local Area Network), also named virtual LAN, is an end-to-end logic network built by network management software which can go across different network segments and networks based on switching LAN.

The standard for QinQ VLAN/VLAN stacking is IEEE802.1ad, which is upgraded from the IEEE802.1Q standard for VLAN. The core concept of QinQ VLAN is to encapsulate the VLAN tags of user's private network in a service VLAN tag of public network so that the users' traffic crosses the provider's backbone network with two layers of tagging, which provides users with a relatively simple Layer-2 VPN tunneling. This can effectively overcome the VLAN ID addressing space limit of 4k addresses.

QinQ VLAN functions supported by the AN5116-06B are as follows:

- Supports user and service differentiation through VLANs.
- Supports setting subscriber's SVLAN based on card, PON port, or ONU.
- Supports VLAN number extension:

  By adding QinQ VLAN, the number of VLANs is increased to 4096×4096 on the basis of existing VLANs.
- Supports flexible QinQ features:

  The system can add inner or outer VLAN based on the value of source MAC address, destination MAC address, source IP address, destination IP address, L4 source port No., L4 destination port No., Ethernet type, inner VLAN ID, outer VLAN ID, service type, time-to-live, protocol type, L1 CoS, and L2 CoS.
- Supports selective QinQ for one port.

  Configuration of basic QinQ and selective QinQ at the same time on a port – allowing both double-tagged and single-tagged services.

VLAN translation function supported

VLAN translation means that OLT or ONU equipment transforms user side VLAN tags into network side VLAN tags. This can reduce carriers' maintenance workload and protect the distribution layer network and core network.

The VLAN translation function provided by the AN5116-06B can be in one of the following three forms:

- 1:1 translation:

  The uplink data VLANs of each subscriber are transformed into the corresponding network side VLANs. That is, the subscriber data VLANs correspond to network side VLANS one by one.

- N:1 translation:

  VLAN convergence function. Converges a number of uplink VLANs into a unique network-side VLAN; and maps the network-side VLAN into corresponding multiple VLANs in the downlink direction.

- Hybrid translation:

  Supports combined use of 1:1 VLAN translation and N:1 VLAN translation.

1.2.9 QoS Guarantees

The AN5116-06B has powerful QoS guarantee mechanisms and supports end-to-end QoS solution through the entire network. For different users and services, it provides network service of different qualities and provides the foundation for management of various services.

QoS ability of EPON

- Supports uplink port's flow-based policies, including packet filter, re-direction, flow mirroring, traffic statistics, traffic monitoring, queue scheduling, rate control, priority policing and translation.
- Supports uplink port's packet filtering and classification based on source MAC address, destination MAC address, Ethernet type, VLAN, CoS, source IP address, destination IP address, IP port and protocol type.
- The OLT supports three queue scheduling mechanisms: SP (Strict Priority), WRR (Weighted Round Robin) and SP+WRR; and each port has eight CoS queues.
- Supports CoS remarking and CoS copy:

  Changes the original CoS value in the subscriber's data message, or copies the CoS value of the CVLAN to the SVLAN.

- Supports flow labeling and shaping.
- Supports 1024 QoS rules.
- Supports rate control of ports.
- Supports bandwidth control of EPON port, with a granularity of 1 kbit/s.
- Supports multi-LLID technology.

  Each ONU supports up to eight LLIDs, which are classified based on source MAC address, destination MAC address, source IP address, destination IP address, TCP, UDP, ToS, CoS, Ethernet type and protocol type.

QoS ability of GPON

- Supports uplink port's flow-based policies, including packet filter, re-direction, flow mirroring, traffic statistics, traffic monitoring, queue scheduling, rate control, priority policing and translation.
- Supports uplink port's packet filtering and classification based on source MAC address, destination MAC address, Ethernet type, VLAN, CoS, source IP address, destination IP address, IP port and protocol type.
- The OLT supports three queue scheduling mechanisms: SP, WRR and SP +WRR; and each port has eight CoS queues.
- Supports CoS remarking and CoS copy:

  Changes the original CoS value in the subscriber's data message, or copies the CoS value of the CVLAN to the SVLAN.
- Supports flow shaping, and supports dynamic adjustment of the traffic output rate. The OLT performs data buffering, and sends out the data when there is available bandwidth.
- Supports traffic policing, monitoring a certain kind of traffic that enters a certain interface.
- Supports 1024 QoS rules.
- Supports the DBA (Dynamic Bandwidth Allocation) algorithm with a control granularity of 64 kbit/s.
- Provides flexible QoS and SLA functions:

Classifies priority queues according to MAC address, 802.1p priority, 802.1q VLAN tag, IP ToS, IP address and TCP / UDP address; supports maximally eight service-levels.

- Supports uplink port's flow-based rate limiting and mirroring.
- Supports T-CONT type 1 to type 5 service scheduling.
- Provides uplink DBA and SBA functions, supporting both SR (Status Report) mode and NSR (None Status Report) mone of DBA.

1.2.10 Security Mechanisms

Designed with carrier-class reliability, the AN5116-06B can fully guarantee the security of subscribers' services.

System side security insurance measures

- Supports L2 to L7 packet filtering, performing illegal frame filtering based on source MAC address, destination MAC address, source IP address, destination IP address, port No., Ethernet type, protocol type, VLAN and VLAN range, so as to prevent illegal attempts to access the Internet.
- Supports protection against DOS attack to enhance the anti-attack capability.
- Supports ACL (Access Control List)-based permission / denial controls.
- Supports protection against ICMP (Internet Control Message Protocol) / IP message attack.
- Supports protection against ARP (Address Resolution Protocol) attack.
- Both GUI and CLI network management systems can provide operator accounts with different operating authorities, so as to ensure operating security of the network management system.
- Supports automatic reporting of ONU SN and MAC address to the network management system.
- Supports authenticating ONU based on physical address, logic identifier, logic identifier + password, hybrid authentication 1 (logic identifier + physical address), hybrid authentication 2 (logic identifier + password + physical address).
- Supports broadcast storm control.

- Supports frame filtering and rate limiting.

Subscriber side security measures

- Supports access security control through DHCP Option-82 and PPPOE+. The AN5116-06B can insert physical information into protocol messages of DHCP request dial or PPPOE dial. When used in combination with a verifying system, it can effectively and dynamically control subscriber access to specific network resources, so as to greatly facilitate troubleshooting and attack positioning.
- Supports DHCP snooping. The ONU snoops subscriber information such as MAC address, IP address, lease time and VLAN ID, so as to trace and locate DHCP subscriber's IP address and port by establishing and maintaining a DHCP snooping binding table. In addition, it directly discards illegal messages (ARP spoofing messages and the messages that modify IP address randomly). These illegal messages are not compliant with the binding table entries. Therefore, it guarantees DHCP environment integrity and consistency.
- Supports limit on the maximum number of MAC addresses learned, to prevent MAC attack.
- Supports limit on the number of MAC addresses that access a single FE interface of an ONU.
- Supports limit on the number of multicast groups that a single FE interface of an ONU can join.
- Supports port binding, such as dynamic binding of FE interface and MAC address, to guarantee validity of subscribers accessing the network.
- Supports AES-128 encryption and decryption algorithm to guarantee the security of subscribers' data.

1.2.11 High Reliability Design

System reliability is a major concern in the system design, software design and hardware design of the AN5116-06B. The equipment provides complete redundancy protection of power supply, fans, cards and interfaces, and optical path protection switching mechanism, so as to ensure the normal operation of the equipment.

Card protection

- Supports hot insertion of cards.
- Supports 1:1 active / standby switching function of the core switch cards to enable seamless switching. After switching of the core switch cards, the configuration of the uplink interface does not need to be changed, which greatly facilitates the user's maintenance and management operations.
- Supports 1+1 active / standby protection function of the uplink interface cards, Trunk protection and dual-homing protection of the uplink interface:
  - When the uplink cards are set to 1+1 active / standby protection, the two uplink card interfaces are one-to-one protected. If GU6F is used as the uplink card, the equipment can provide up to six GE uplink interfaces; if HU1A is used as the uplink card, the equipment can provide up to four GE uplink interfaces and one 10GE uplink interface. If HU2A is used as the uplink card, the equipment can provide up to two GE uplink interfaces and two 10GE uplink interfaces.
  - When the uplink interfaces are set to Trunk, the bandwidth of uplink interfaces can be extended and load equalization for interfaces in the Trunk group is performed automatically. Once an interface of a Trunk group fails, the flow of the failed interface is automatically shared between other interfaces of the Trunk group. The twelve GE uplink interfaces of the two uplink card can form maximally six Trunk groups and each Trunk group can support maximally 12 member interfaces. The 10GE uplink interfaces of the uplink cards can make up maximally two 10GE uplink Trunk groups.
  - When the uplink interfaces are set to dual-homing protection, the two uplink interfaces are connected to the IP bearer network via two sets of uplink equipment to perform dual-homing protection. When one of the two links is found to be in failure, the services on the failed link will be automatically switched to the other link, so as to ensure traffic remains unblocked.
- Supports inter-card protection of the TDM card.

PON chip protection

- Supports 1:1 protection for intracard or intercard PON MAC chips. Controls the switching of the PON MAC chips when a loss of signal is detected on the optical module by hardware.
- Supports 1+1 protection (Type B) at the PON interface; supports protection switching of services on the 50ms trunk line fiber.

Power supply protection

- Two power supply cards work in dual-power input and protect against reverse polarity connection.
- The power supply cards support a distributed power-fed mode and all powered cards are fed with power independently. Any fault in one card does not influence other cards. This greatly improves equipment reliability and stability.

Fan protection

- Provides fan running indicator LEDs to indicate the running status of fans.
- Supports independent installation of fans.
- Supports automatic adjustment of fan speed. When one of the fans fails, the other two fans will adjust their running speed automatically to keep normal operation of the fan unit.

1.2.12 Maintainability and Manageability

The AN5116-06B provides four network management functions: configuration management, security management, performance management and fault management. Together these functions fully guarantee network QoS and facilitate users' routine maintenance and fault diagnosis.

Maintenance measures

- Supports local and remote management measures.
- Supports the GUI and CLI network management systems, and performs uniform management of OLT and ONU via the ANM2000 developed by FiberHome.

- Supports in-band and out-of-band management modes.
- Supports SNMP.
- Supports the Telnet protocol for remote access to and management of the equipment.
- Supports multiple management IPs / VLANs, and allows multiple management servers to manage the same equipment simultaneously.

Terminal management

- As the proxy of the network management system, the OLT performs remote management of an ONU by way of Ethernet OAM (Operation Administration and Maintenance).
- Supports pre-configuration of an ONU by the OLT. When the pre-configured ONU registers, the OLT will configure and authorize it automatically with the saved information. This makes service configuration more convenient.
- Supports automatic detection and testing of an ONU.
- Supports authenticating an ONU based on physical address, logic identifier, logic identifier +password, hybrid authentication 1 (logic identifier+physical address), hybrid authentication 2 (logic identifier+password+physical address).
- Supports interconnection with the carrier’s management system, and receives configuration data from the operator’s management system.

Alarm management

- Provides additional alarm information to help users find causes for alarms and the right solution.
- Supports system log function which can record the key configuration changes to the system to assist fault analysis and isolation.
- Supports signal tracing of speech to facilitate isolating voice service faults.
- Supports PSTN line quality and performance testing (for example, 112 testing made by China Telecom) which can isolate phone line faults.
- Provides performance supervision and detection of optical power levels, facilitating optical line maintenance.
- Provides local and remote loopback function to isolate user line faults.

Performance management

- Supports output of various statistic report forms to facilitate routine maintenance, such as performance statistics report forms and alarm statistics report forms.
- The network management system provides collection, query and analysis of performance data.

Security management

Supports management of the authorities in operating the network management system.

The management system allows different levels of management authority to be defined on a per user basis using the user management setting table. The system verifies each user authority level at login and will restrict that user's operations according to the stored authorities list. Once a user passes the login authentication, menus unauthorized to the user will be greyed and unauthorized equipment hidden.

Environment supervision

- Collects environmental information from the OLT and ONUs (for ONUs equipped with this feature). Collected information can be displayed on the network management system.
- Supports automatic adjustment of fan speed according to ambient temperature.

1.3 List of Functional Features

See Table 1-2 for the functions supported by the AN5116-06B.

Table 1-2 List of functional features

Type	Function
Access features	Access to EPON
	Access to GPON
	Access to 10GPON
	Access to E1 / STM-1
Access to EPON	EPON terminal management
Access to GPON	GPON terminal management

Table 1-2 List of functional features (Continued)

Type	Function
Layer 2 switching functions	Independent learning of MAC addresses
	Shared learning of MAC addresses
	Globally clearing Layer 2 forwarding tables
	Supporting Ethernet port aggregation
	Supporting STP (Spanning Tree Protocol)
	Supporting RSTP (Rapid Spanning Tree Protocol)
QoS functions	Supporting two rate three color based on traffic
	Supporting single rate three color based on traffic
Multicast functions	PIM-SM
	IGMP Proxy/Snooping
	Multicast VLAN
	Copying and broadcasting of multicast
	Statistics of multicast information
	Management of multicast subscribers
	Management of multicast programs
	Multicast service CDR (Calling Detail Records) function
Voice functions	VoIP voice service
	PPPoE configuration
	DHCP configuration
	Query of NGN statistics information
	Query of NGN source status
	Interconnection of same VLANs for voices inside PON
TDM functions	Supporting multiple clock modes
	Online query of E1 status
	Supporting E1 loopback
	Providing E1 and STM-1 uplink interfaces
Layer 3 functions	ARP agent
	RADIUS remote authentication protocol
	Supporting DHCP Relay or Server
	Isolating illegal DHCP server
	Consistency of VRRP
	Sharing between active and standby cards
	Load sharing
	MD5 authentication of VRRP messages

Table 1-2 List of functional features (Continued)

Type	Function
	RIP
	OSPF
	BGP
Networking features	Redundancy backup
	BFD (Bidirectional Forwarding Detection)
Operations and maintenance	Remote operation and user management
	Classification of operation authorities
	Management of equipment abnormality
	Version and data management
	Saving and query of performance statistics and historical data
	Remote upgrading of software
Clocks	Clock inside the system
	BITS clock
	E1 line clock
	1588v2 clock
	Recovering the self-adaptive clock
	Synchronizing the Ethernet clock
System redundancy backup functions	Intercard 1 +1 protection for PON interfaces
	Intracard 1 +1 protection for PON interfaces
	Supporting redundant uplink cards
	Supporting redundant core switch cards
	Supporting redundant power supply cards
Environment supervision functions	Collecting environmental information about the OLT equipment room
	Collecting environmental information about the ONU

2 Product Application

This chapter introduces applications of the AN5116-06B.

- ☑ Networking Introduction
- ☑ Technical Application
- ☑ Site Applications

2.1 Networking Introduction

The AN5116-06B is suitable for FTTH / FTTB / FTTC / FTTV / FTTM application. Usually it is placed in a residential community or central office.

An illustration of the of the AN5116-06B's networking diagram is shown in Figure 2-1.

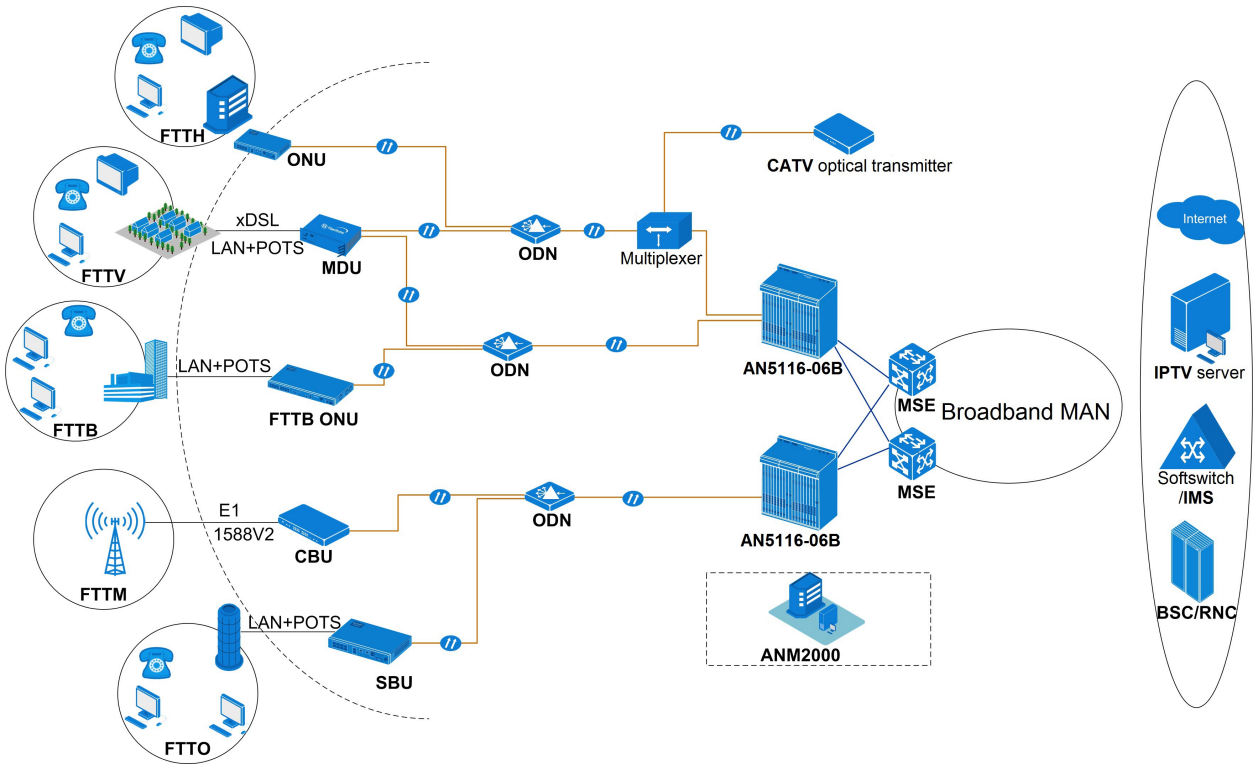


Figure 2-1 The AN5116-06B networking diagram

2.2 Technical Application

This section introduces the technical application of the AN5116-06B.

2.2.1 Triple Play Application

The AN5116-06B can provide subscribers simultaneously with multimedia services such as data, voice and video services, and provide QoS guarantees accordingly.

The AN5116-06B supports the following three Triple play solutions:

- EPON Triple-play solution

  The EPON ONU uses different VLANs to classify different service flows which are mapped to the same LLID and transported to the AN5116-06B via the EPON line.

- GPON single GEM port Triple-play solution

  Supports classifying service flows based on Ethernet type, VLAN ID of subscriber side messages and subscriber side 802.1p domain, and supports control of service flows. This solution is achieved by using the AN5116-06B together with the AN5506-15/16 or AN5006-20.

- GPON multiple GEM port Triple-play solution

  Classifies different service flows by different GEM ports, and maps different services to different GEM ports according to VLAN ID, 802.1p or physical ports and then delivers them to the AN5116-06B via the GPON line for processing.

See Figure 2-2 for an illustration of the AN5116-06B Triple-play application.

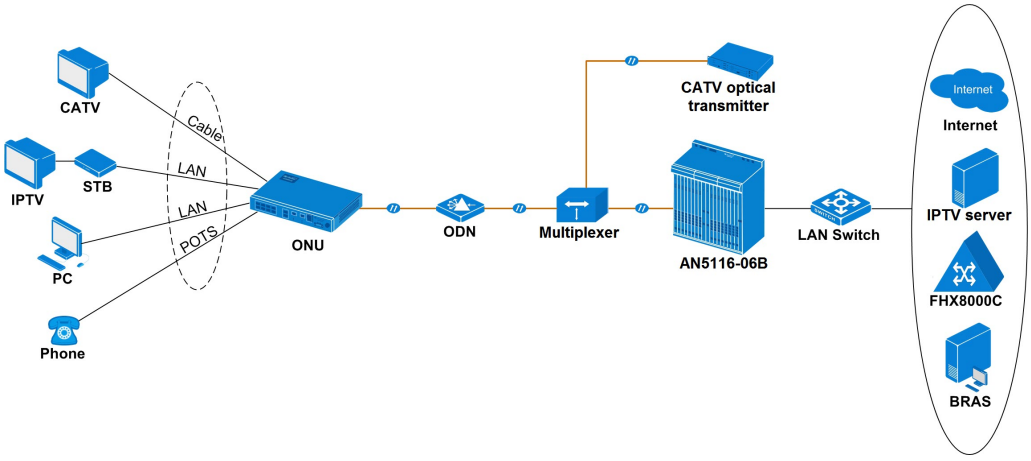


Figure 2-2 The AN5116-06B Triple Play Application

2.2.2 QinQ VLAN Application

The AN5116-06B supports QinQ VLAN application to overcome restriction on VLAN number resource in network, and allow separation and unique identification of subscribers as well as classification of service types.

See Figure 2-3 for an illustration of the AN5116-06B QinQ VLAN network.

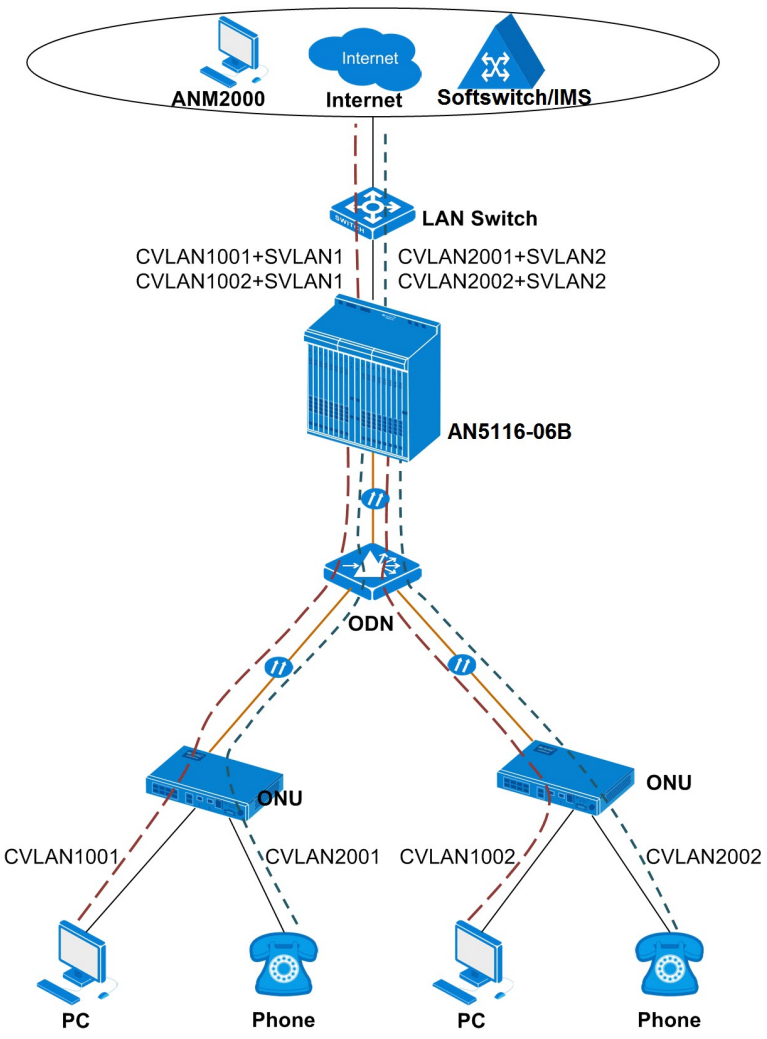


Figure 2-3 The AN5116-06B QinQ VLAN application

Data messages transferred in an IP backbone network have two layers of VLAN tags. On the internal layer is the Customer-VLAN tag, and on the external layer is the Service-VLAN tag. The roles of these tags in the network are as follows:

- On the equipment side of the AN5116-06B

Data and voice services of two subscribers access the AN5116-06B via ONUs. The Customer-VLAN tags for data and voice services used by ONU1 are respectively 1001 and 2001; and the Customer-VLAN tags used by ONU2 are 1002 and 2002. When the two subscribers' services are transported to the AN5116-06B by the ONU, they are labeled with Service-VLAN tags according to the different types of data and voice services. Then the subscribers' services with double VLAN encapsulation are forwarded to the provider's network.

- On the network side of the AN5116-06B

  Data messages are transported in the IP backbone network as per Service-VLAN ID. When the messages go downlink and reach the AN5116-06B on the opposite end, the Service-VLAN tags of the messages are stripped, and then the messages are transported to ONUs via PON lines. Then the ONUs strip the Customer-VLAN tags of the messages and transmit the data packets to user terminals.

2.2.3 VLAN Translation Application

The AN5116-06B supports VLAN translation application. In the VLAN translation networking solution, subscriber messages with tags are assigned with VLAN IDs of a private or public network.

VLAN translation is also known as VLAN mapping. The use of VLAN translation can distinguish subscriber services on the network side, reduce maintenance work and conserve limited VID resources since only one SVLAN is needed for a system.

When various service flows at the subscriber side go through terminal equipment supporting 802.1q (take a home gateway as an example), the terminal equipment may only support fixed tags. These fixed tags may be out of the valid range defined by the operator. The ONU will strip the default tags added by the terminal equipment and substitute them with valid tags when the services are received at the ONU. There are three types of translation: 1:1 VLAN translation, N:1 VLAN translation, and hybrid translation.

- 1:1 VLAN translation

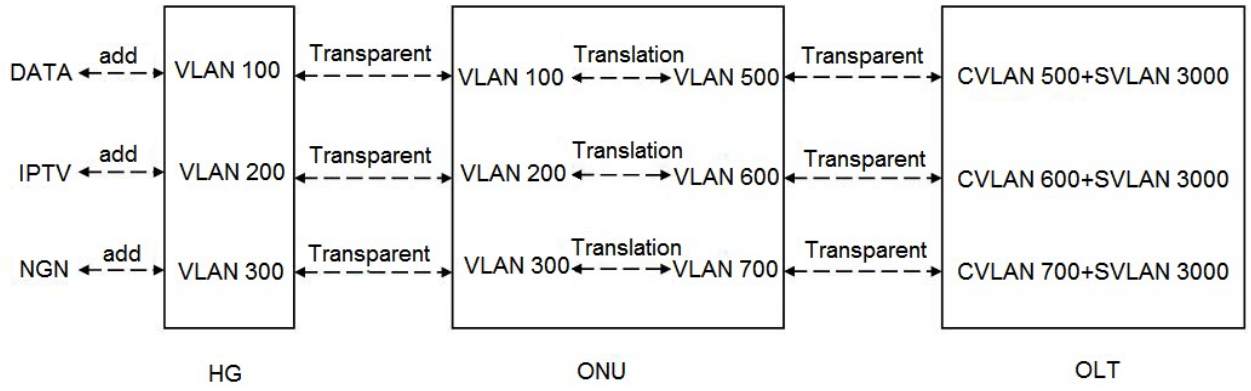


Figure 2-4 1:1 VLAN translation

- At the subscriber side of the AN5116-06B, the subscribers' data, voice, and multicast services go through gateways and are labeled with fixed default VLAN tags (for example 100, 200, 300 respectively). When the subscribers' services are received at the ONU configured for 1:1 VLAN translation, the ONU will substitute the configured Customer-VLAN tags for data, voice and multicast services (for example 500, 600, and 700 respectively).
- At the network side of the AN5116-06B, when the services are sent to the AN5116-06B, they are labeled with the Service-VLAN tags (for example 3000) on the AN5116-06B. When the QinQ VLAN processing is finished, the subscriber services with double VLAN encapsulation are forwarded to the provider's network.

◆ N:1 VLAN translation

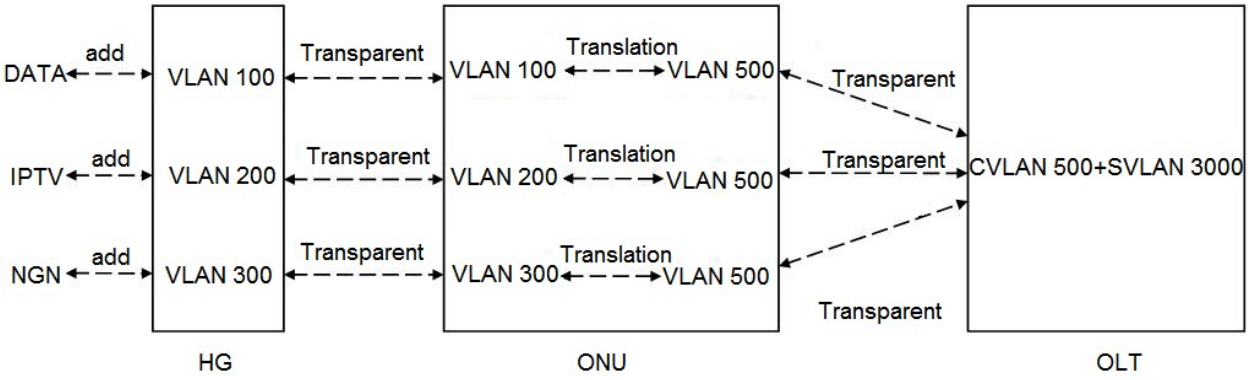


Figure 2-5 N:1 VLAN translation

- At the subscriber side of the AN5116-06B, the subscribers' data, voice, and multicast services go through gateways and are labeled with fixed default VLAN tags (for example 100, 200, 300 respectively). When the subscribers' services are received at the ONU configured for N:1 VLAN translation, the ONU will substitute a single configured Customer-VLAN tag for all services (for example 500).
- At the network side of the AN5116-06B, when the services are sent to the AN5116-06B, they are labeled with the Service-VLAN tags (for example 3000) on the AN5116-06B. When the QinQ VLAN processing is finished, the subscriber services with double VLAN encapsulation are forwarded to the provider's network.

◆ Hybrid VLAN translation

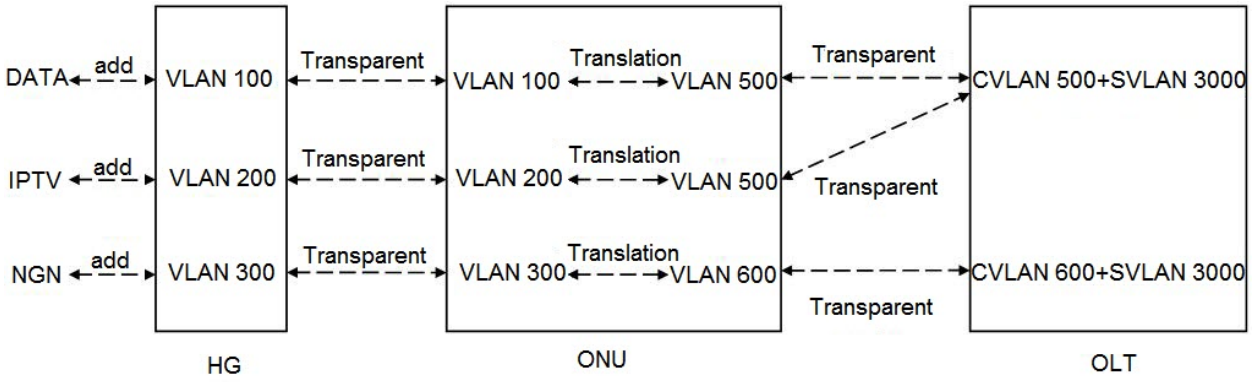


Figure 2-6 Hybrid VLAN translation

Hybrid VLAN translation comprises 1:1 VLAN translation and N:1 VLAN translation. See below for description of networking in this mode.

- At the subscriber side of the AN5116-06B, the subscribers' data, voice, and multicast services go through gateways and are labeled with fixed default VLAN tags (for example 100, 200, 300 respectively). When the subscribers' services are received at the ONU configured for hybrid mode VLAN translation, the ONU will substitute a unique Customer-VLAN tag for some services (for example voice services are labeled 600) and a single configured Customer-VLAN tag for some groups of services (for example 500 for date and multicast services).

- At the network side of the AN5116-06B, when the services are sent to the AN5116-06B, they are labeled with the Service-VLAN tags (for example 3000) on the AN5116-06B. When the QinQ VLAN processing is finished, the subscriber services with double VLAN encapsulation are forwarded to the provider's network.

2.2.4 IPTV Service Application

The AN5116-06B supports IPTV service application. The subscriber side and network side interfaces of the AN5116-06B support IGMP V2/V3, and can provide flexible multicast solution.

The AN5116-06B supports uniform control and management of multicast service access authorities, making record and statistics of subscriber multicast information, and controlling multicast program sources. The multicast service in controllable mode can effectively prevent protocol attacks, illegal multicast sources, illegal rebroadcasting, and illegal receivers, so as to protect the operator's interests.

The AN5116-06B transmits multicast service in SCB+IGMP mode, and performs multicast service control and management via multicast control messages. The IPTV service application for the AN5116-06B is illustrated in Figure 2-7.

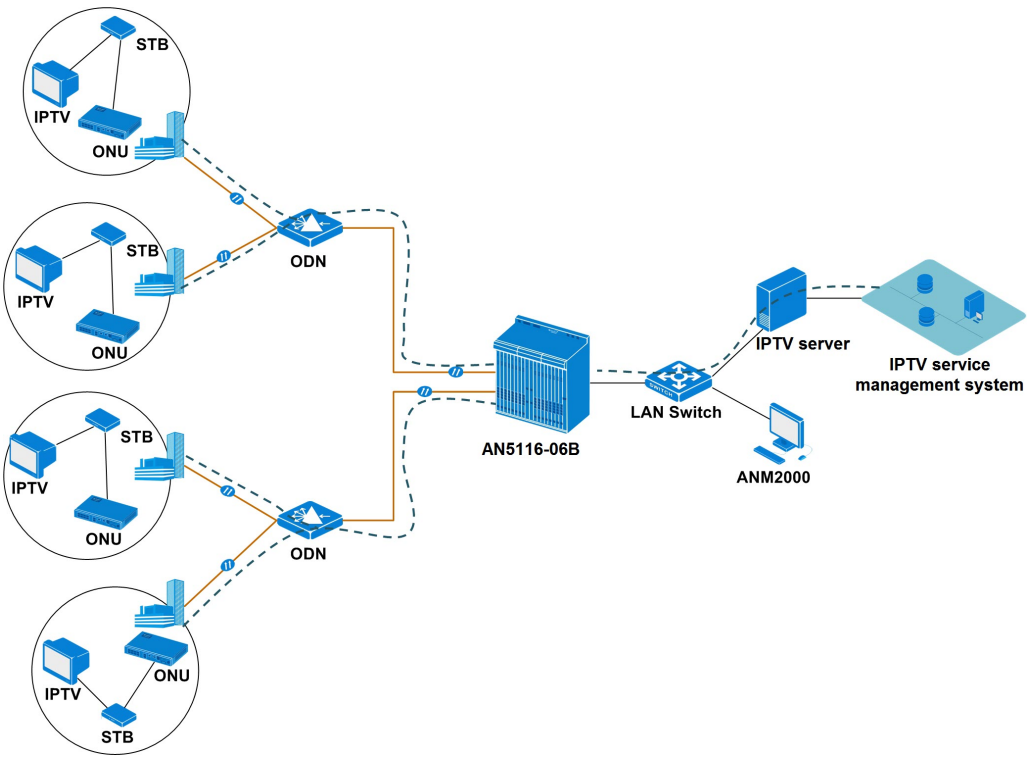


Figure 2-7 The AN5116-06B multicast service application

The multicast service supports three working modes: IGMP Snooping mode, IGMP Proxy mode and controllable mode.

- IGMP Proxy mode

  The AN5116-06B works in IGMP Proxy mode and the ONU works in IGMP Snooping mode. When the OLT receives an IGMP join message from a certain subscriber, it captures this message and performs authentication. The OLT will perform the following operations when the message has passed the authentication:

  - If the multicast group to join does not exist in the multicast forwarding table of the OLT, the OLT will send an IGMP join request to the multicast server and create this group in the table.
  - If the group already exists in the table, the OLT will add the subscriber to the table and set the corresponding relationship between the multicast service and the subscriber.

- IGMP Snooping mode

Both the OLT and ONUs work under the IGMP Snooping mode, and multicast messages will be broadcast to all EPON / GPON interfaces and all ONUs.

- Controllable mode

  In the controllable mode, the AN5116-06B controls and manages the access of subscribers to multicast service, performs subscriber multicast information recording and statistics, and controls and manages multicast program sources. This can effectively prevent protocol attacks, illegal multicast sources, illegal rebroadcasting, and illegal receivers, so as to protect the operator's interests.

2.2.5 VoIP Service Application

The AN5116-06B supports VoIP functions, providing voice services with carrier class quality, and allowing IP-based voice service access.

The AN5116-06B supports MGCP, H.248 and SIP, and its softswitch interface can be connected to MGC gateways produced by various mainstream manufacturers. See Figure 2-8 for an illustration of the AN5116-06B VoIP service application.

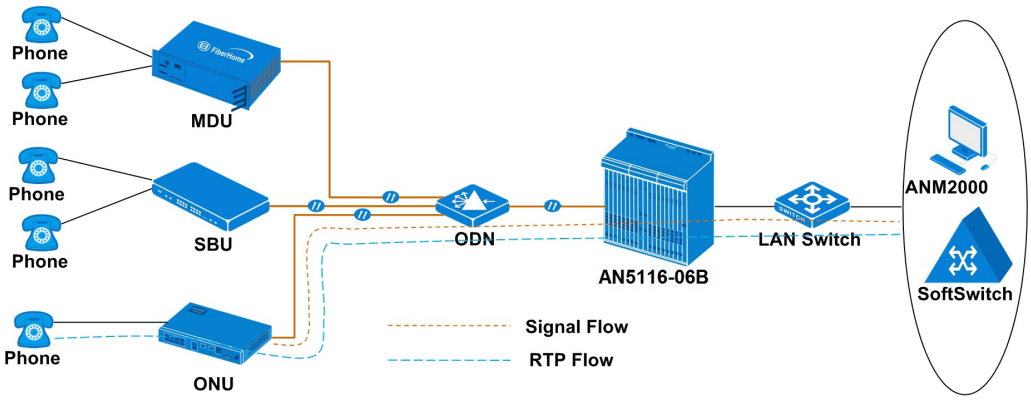


Figure 2-8 Application of the AN5116-06B in VoIP service

When a standard analogue telephone is attached to the RJ-11 port of an ONU and VoIP services are configured, the ONU will: perform analogue to digital conversion of the voice signal, encode the digital stream as appropriate, perform a speech compression algorithm to minimize bandwidth requirements, and encapsulate the voice data in an IP packet for transmission to the providers network through the OLT. The VoIP call will be established via the external softswitch MGC.

2.2.6 TDM Service Application

The AN5116-06B supports TDM service application. It protects investment in traditional TDM network, and uses CES technology to enable TDM over IP, so as to achieve All-IP network architecture.

The AN5116-06B supports both asynchronous and synchronous clock modes and thus provides a highly reliable transport solution for all services requiring E1 TDM interfaces. See Figure 2-9 for an illustration of the AN5116-06B TDM service application.

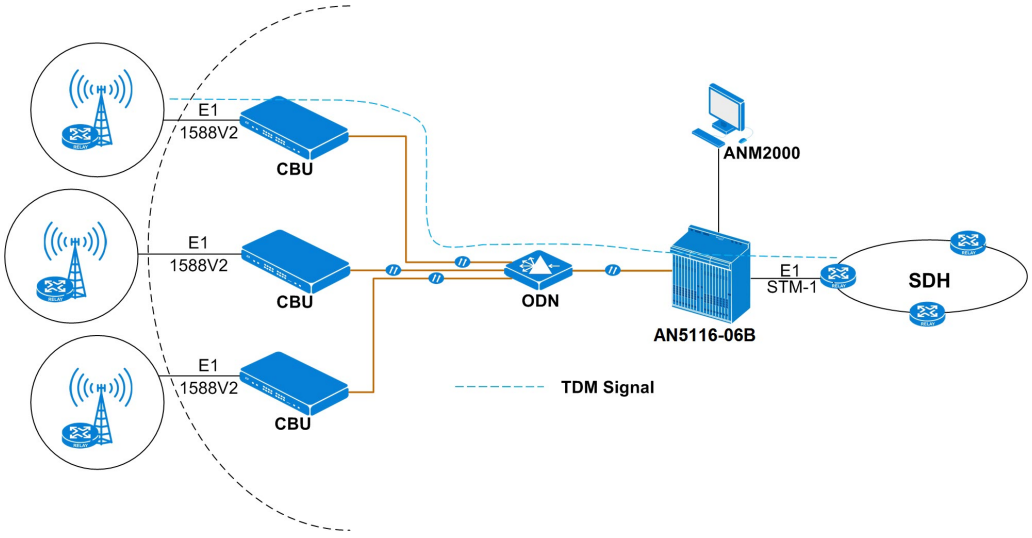


Figure 2-9 Application of the AN5116-06B in TDM service

2.2.7 CATV Service Application

The AN5116-06B supports CATV service application. It supports access of traditional cable TV (CATV) and enables triple play.

The CATV signal source is optical signal produced by CATV optical transmitter. The signal is combined with the AN5116-06B's EPON / GPON signals in a single fiber for transmission using a WDM multiplexer. Then CATV signals are demultiplexed and converted from the optical domain to the RF domain at remote end ONU. Subscribers can connect a TV set to the RF interface of the ONU to access the CATV service. See Figure 2-10 for an illustration of the AN5116-06B CATV service application.

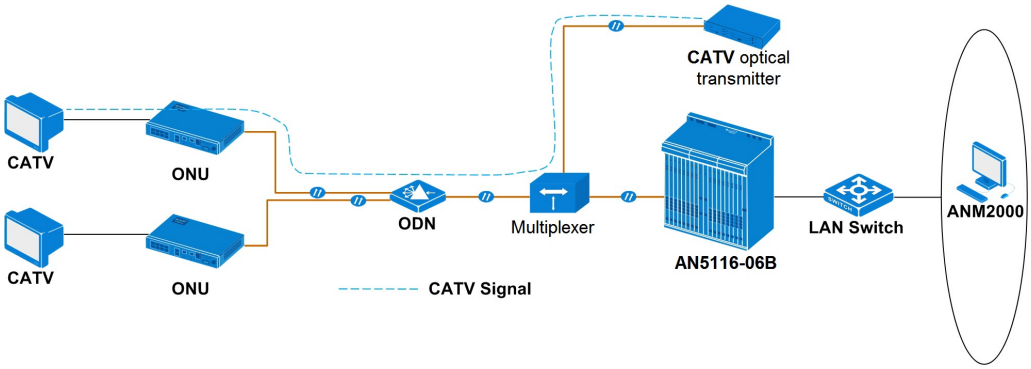


Figure 2-10 Application of the AN5116-06B in CATV service

2.2.8 Wi-Fi Service Application

The AN5116-06B supports Wi-Fi service application. It allows access of wireless terminals and wired terminals via home gateway device, so as to meet various demands of subscribers.

The AN5116-06B supports two types of home gateways: GPON uplink interface and EPON uplink interface. The home gateway covers homes, schools and public areas via wireless network to allow wireless access of terminal devices such as laptops and mobile phones. The home gateway supports simultaneous access of data, voice and multicast services to allow Triple-play. See Figure 2-11 for an illustration of the AN5116-06B Wi-Fi service application.

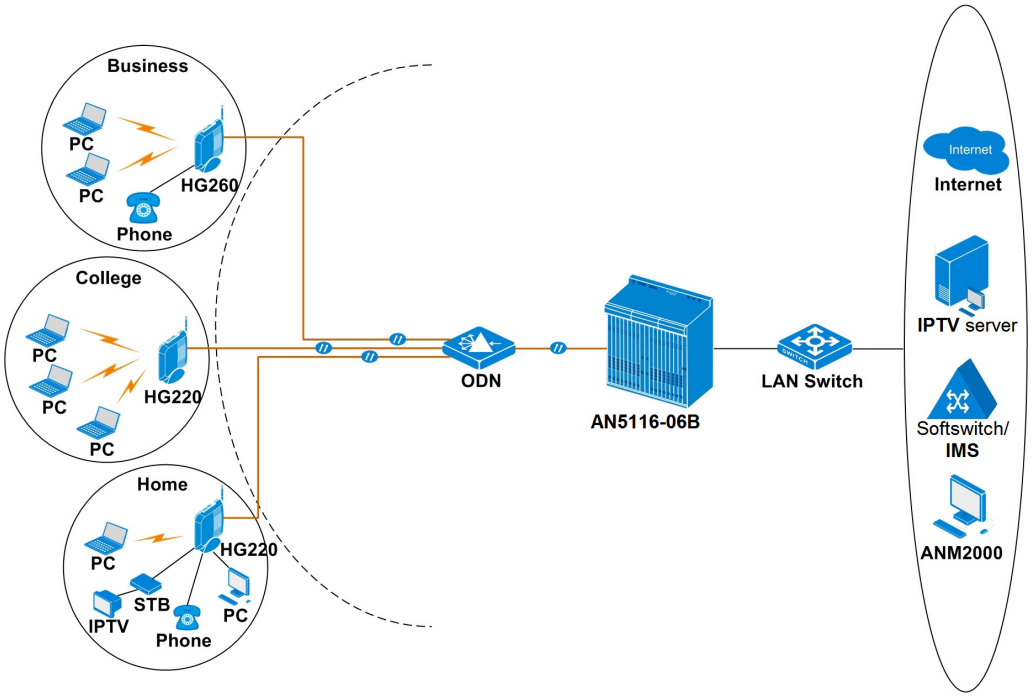


Figure 2-11 Application of the AN5116-06B in Wi-Fi service

2.3 Site Applications

This section introduces site applications of the AN5116-06B.

2.3.1 Application in Business Buildings

Subscribers in business buildings have relatively high ARPU (Average Revenue Per User) and denser locations. They occupy an important position in the operator's target market.

Incorporating voice, data, TDM and video services, the AN5116-06B is the best choice for business subscribers. The AN5116-06B can provide subscribers with the following services.

- Broadband data access: Ethernet interface based;
- Voice service access: plain old telephone service based, also via some intelligent terminals (with Ethernet interfaces);

- Video service access: coaxial cable interface based CATV service or Ethernet interface based IPTV service;
- Private line service access: E1 interface based TDM service.

In the business building site applications, the AN5116-06B supports FTTH ONU, CBU ONU and MDU ONU. The MDU ONU can be further subdivided into types such as LAN and xDSL, as shown in Figure 2-12.

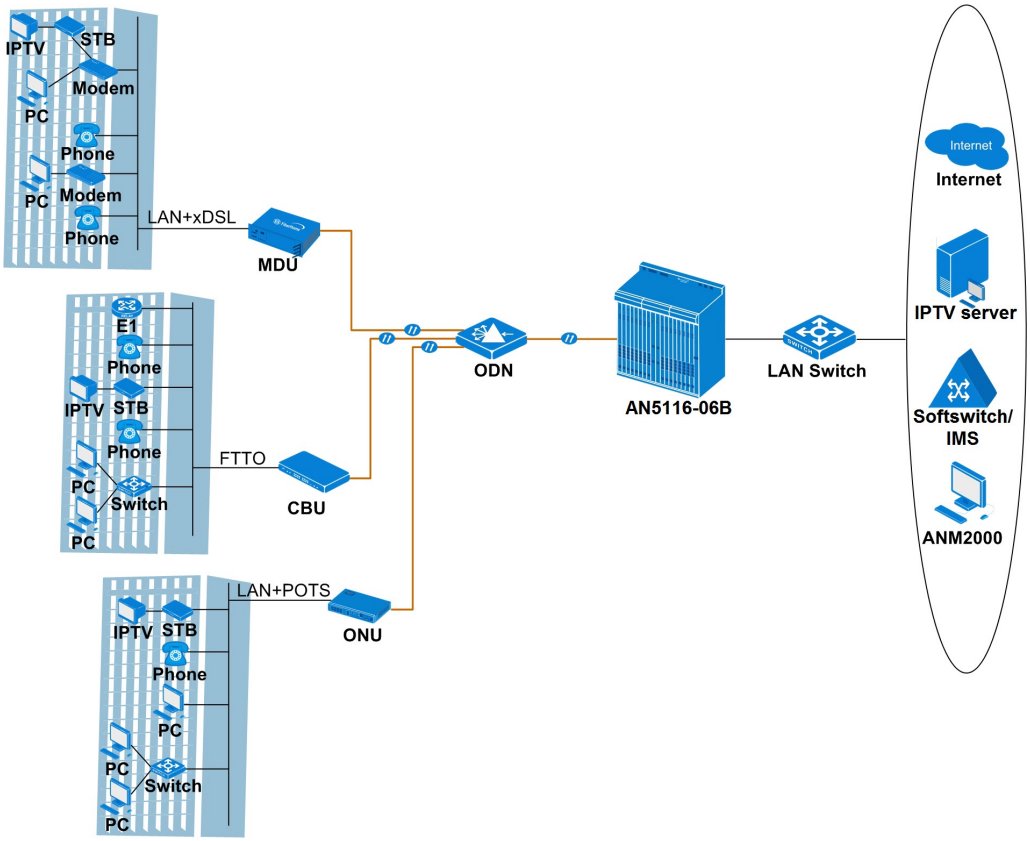


Figure 2-12 Application of the AN5116-06B in business buildings

- It is recommended that Fiber to the Office (FTTO) is used in newly-built business buildings.
  - If subscribers only need data or telephone service, the AN5006 / AN5506-04 is the recommended ONU.
  - If TDM private line service is also needed, the AN5006 / AN5506-06A or the AN5006-20 (equipped with the TDM interface card) are recommended ONUs. The AN5116-06B also needs to be equipped with the TDM card to support TDM private line service.

- For existing business building sites which already have installed LAN or telephone line networks, it is recommended to use LAN or xDSL MDU to upgrade the existing network or equipment thus saving the cost of installing a new network.
  - The AN5506-07 / 09 / 10 or the AN5006-07 / 09 / 10 is the recommended LAN MDU.
  - The AN5006-20 is the recommended xDSL MDU.

2.3.2 Intelligent Home Application

Applying EPON technology to intelligent homes allows more and more families to obtain information via a broadband access network. This information service provided can be highly diversified and are becoming more and more comprehensive and layered. Currently, these information services include: family information service, home automation, public service, and property management services. Examples of these services include such services as remote meter reading (including water, electric and gas meters), building intercom, public facilities management, exit and entry control, public broadcast, and resident archive management.

The AN5116-06B supports property management, and provides management interfaces for connecting the property management server. Property companies can access the property management server via the management interfaces.

The ONUs used together with the AN5116-06B provide dry contact interfaces, so as to provide intelligent homes with monitoring services such as door-entry control, fire fighting, room temperature, supply voltage and smoke alarms. On receiving environmental alarms, the dry contact interfaces will report the environmental conditions immediately to the network management system. The subscribers will then be alerted, so that they can take measures accordingly to avoid damages.

In intelligent home application, the AN5116-06B supports LAN MDU or xDSL MDU. See Figure 2-13 for an illustration of the AN5116-06B intelligent home application in FTTH mode.

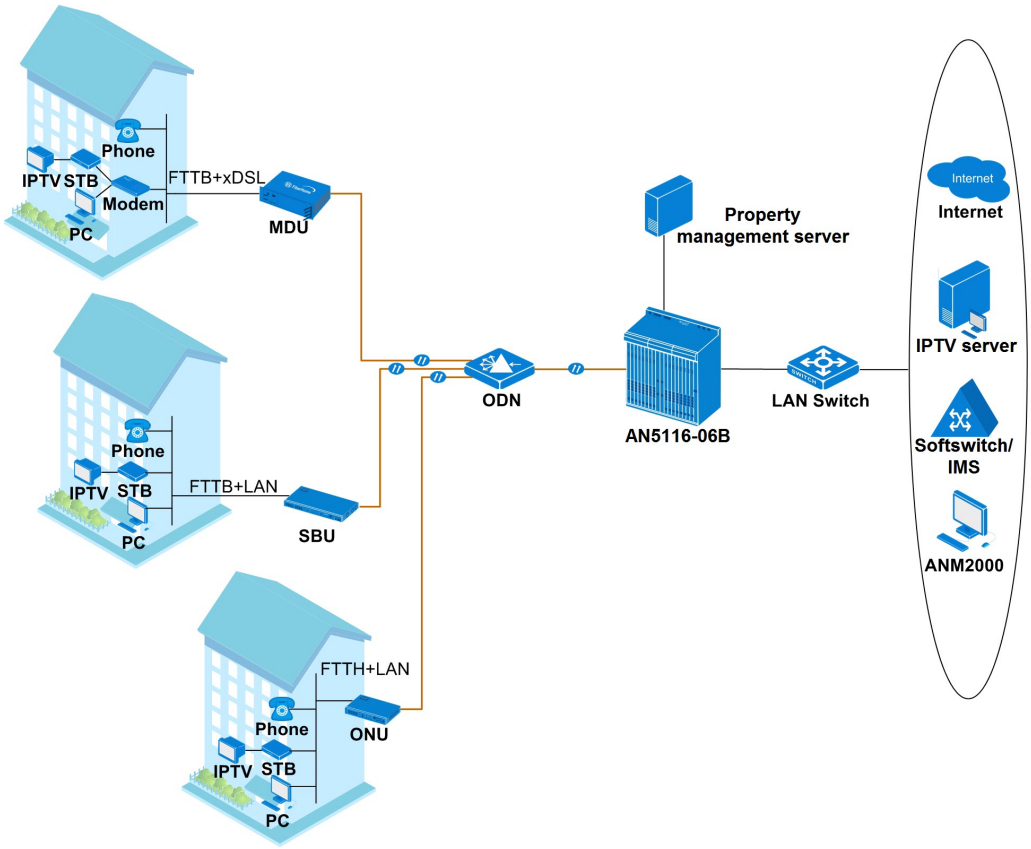


Figure 2-13 Application of the AN5116-06B in intelligent home

- New construction can use FTTH.
- Existing communities may opt to use either FTTH or, when this architecture cannot be supported, FTTB.
  - The AN5006-07 / 09 / 10 or the AN5506-07 / 09 / 10 is recommended as the ONU of choice for a LAN MDU.
  - The AN5006-20 is the recommended ONU for an xDSL MDU.

2.3.3 Internet Cafe Application

In Internet cafes, the access rates are typically 10 Mbit/s, 20 Mbit/s and 100 Mbit/s, and the service types are simple, based on high-rate Internet private line access, plus some possible voice service. Internet cafes are not usually clustered but are more often geographically scattered. They require a network system with a large service area capability. Therefore, FTTx becomes the first choice for most Internet cafes.

The AN5116-06B fully meets the requirements of both data and voice services. It satisfies the requirement to obtain high-rate Internet private line service and voice service through a single fiber, and performs uniform management by the same network platform. See Figure 2-14 for an illustration of the AN5116-06B Internet cafe application.

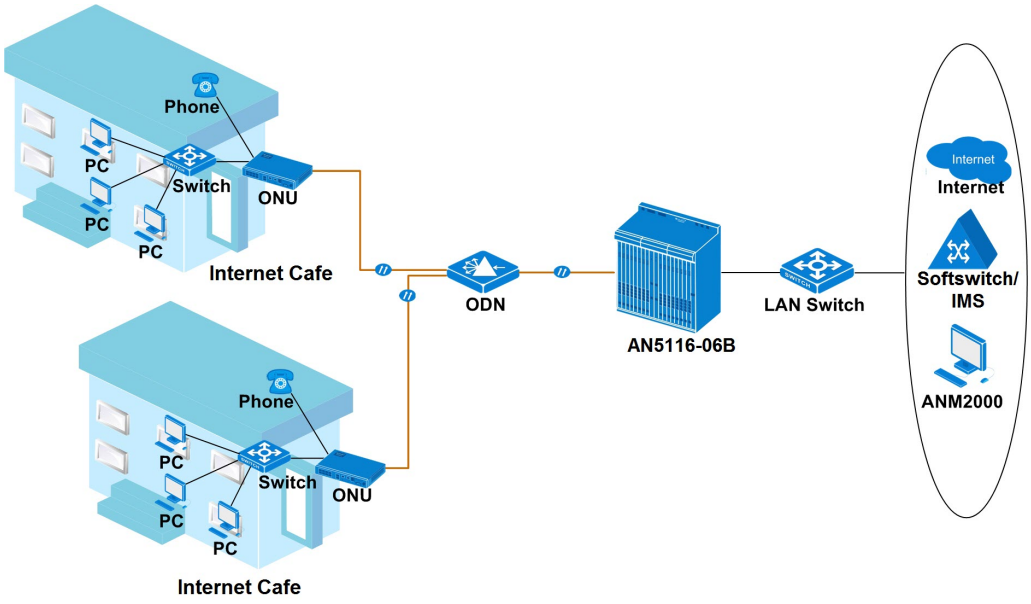


Figure 2-14 Application of the AN5116-06B in Internet cafe

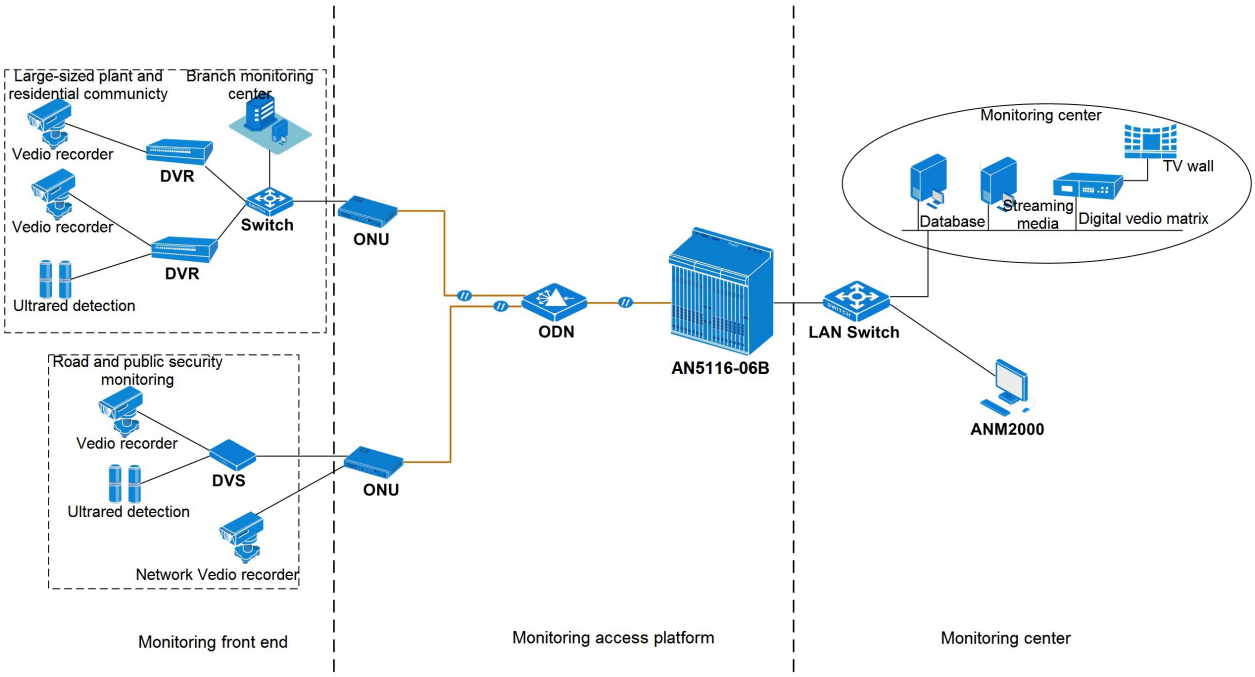
Data and voice services from multiple Internet cafes are aggregated at one AN5116-06B via a splitter.

- For medium and large sized Internet cafes, the AN5006-07/09/10 and AN5506-07/09/10 or the AN5006-20 (shelf-based MDU ONU) are recommended ONUs.
- For small-sized Internet cafes, the AN5006-03/04 or AN5506-03/04 are recommended ONUs.

2.3.4 Urban Security Monitoring Application

While planning a network to address Urban Security Monitoring, “digital monitoring” is a key factor and must be taken into account. Numerous digital video recorders will be dispersed throughout the urban area requiring long transmission distances and high bandwidth. If an EPON / GPON system is used to implement the digital monitoring service, the above requirements can easily be satisfied.

See Figure 2-15 for an illustration of the AN5116-06B application in urban security monitoring.



DVR: digital video recorder; DVS: digital video server

Figure 2-15 Application of the AN5116-06B in Urban Security Monitoring

It is recommended to use the AN5006/AN5506-03 ONU together with the AN5116-06B to perform the urban security monitoring.

- Monitoring front end

  The video signals of the video camera are encoded via the network video server or digital video recorder. After that, the network video signals are transmitted to the switch for convergence, and then sent to ONUs.

Network video cameras can be directly used on the monitoring front end, which transmit network video signals to the switch for convergence. The converged signals are then sent to the ONU.

- Monitoring access platform

  The ONUs transport the network video signals to the AN5116-06B via the EPON / GPON line, and the AN5116-06B sends the converged network video signals to the monitoring center via the uplink interface.

- Monitoring center

  The monitoring center saves the network video signals received from the AN5116-06B, and keeps these data in the event subsequent information processing or access is needed by the various city management functional departments. Meanwhile, network video signals are displayed on the TV wall via digital video matrix, so as to facilitate remote commands in case of emergencies.

This solution allows access of voice services at the monitoring points as well as access of digital monitoring signals. Communication with functional departments such as public security and firefighting departments is enabled in real time in case of emergencies.

2.3.5 Mobile Base Station Applications

As the number of users increases and the bandwidth demands of next generation mobile networks increase, additional mobile base stations which serve as the basic nodes of the mobile communication network, must be deployed. A single EPON / GPON system of the AN5116-06B can support up to 256 / 512 base stations meeting the increase in demand for new base stations.

The AN5116-06B supports transmission distance of up to 20 km, which is well suited to the requirements of the decentralized distribution of base stations. Furthermore, the AN5116-06B supports multiple QoS guarantees and multi-LLID technology. These features guarantee high quality of E1 services at mobile base stations. See Figure 2-16 for an illustration of the AN5116-06B mobile base station application.

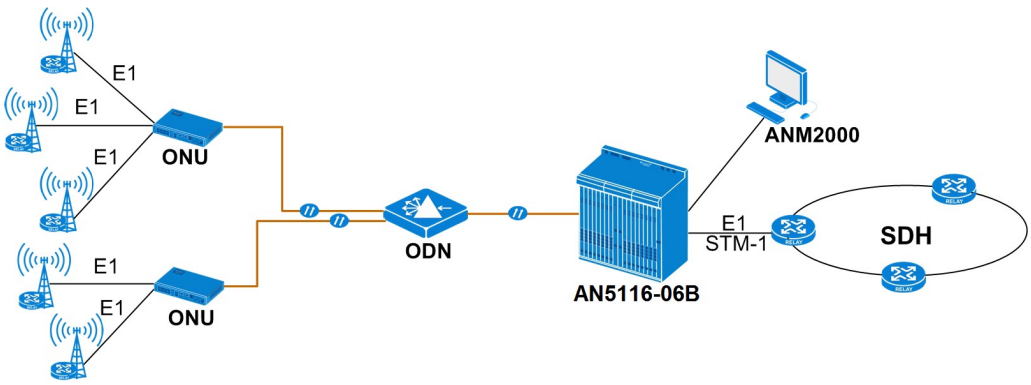


Figure 2-16 Application of the AN5116-06B in mobile base station

The AN5116-06B is used together with E1 ONUs (namely the AN5006–06A / AN5506-06A) or shelf-based ONU (the AN5006-20 equipped with a TDM interface card). These ONUs provide E1 interfaces to connect the base station services.

Meanwhile, the AN5116-06B provides multiple E1 electrical interfaces to convert the Ethernet encapsulated data into TDM data flows using CES technology. The AN5116-06B can also support one or more STM-1 interfaces that can be used to aggregate the TDM services from multiple base stations. The E1 or STM-1 interfaces are then connected to the transmission network.

3 Product Composition

This chapter introduces the hardware and software composition of the AN5116-06B. It includes the following sections:

- ☑ Logical Structure
- ☑ Hardware Structure
- ☑ Software Architecture

3.1 Logical Structure

The AN5116-06B takes full-10GE switching and IP packets as its core. The core switch card is connected to various service cards via a high-speed interconnection bus. The core switch card aggregates data from the service cards and forwards it to the uplink card or TDM cards for transmission to the upper level network.

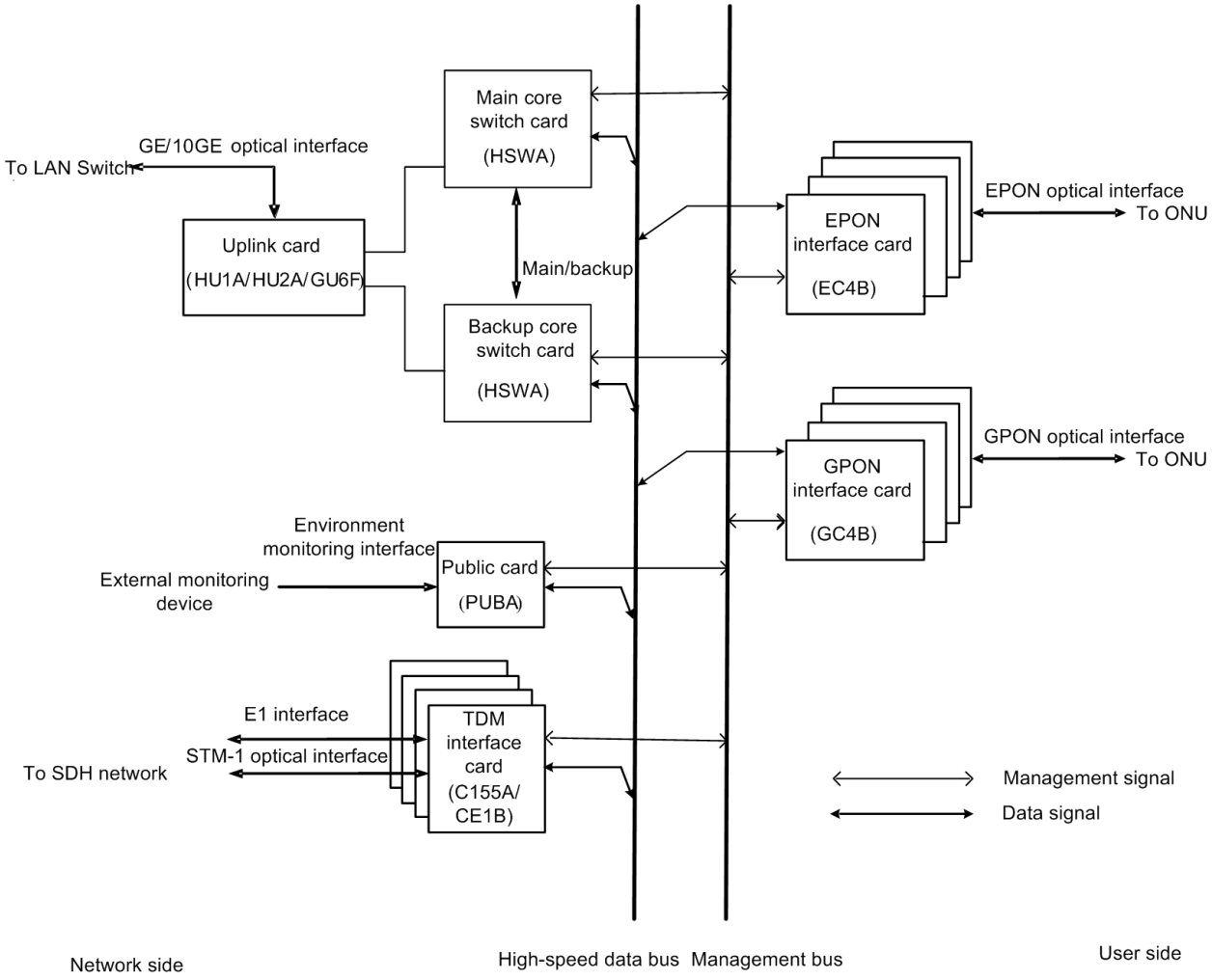


Figure 3-1 Logic structure of the AN5116-06B

- The left side of the figure shows the network side of the AN5116-06B where uplink cards or TDM interface cards transmit service signals to various transmission networks. The public card collects environmental information from external dry contact devices.

- The right side of the figure is the subscriber side of the AN5116-06B where the EPON / GPON interface cards are connected to the ONUs via the ODN. The core switch cards manage other cards inthe system through the management bus.

3.2 Hardware Structure

This section introduces the hardware structure of the cabinet, PDP, subrack and cards.

3.2.1 19-inch Cabinet

This section introduces the 19-inch cabinet used by the AN5116-06B. When the AN5116-06B subrack is equipped with the TDM interface card, the 19-inch cabinet should be used.

3.2.1.1 Appearance

This section introduces the appearance of the 19-inch cabinet.

See Figure 3-2 for the appearance of the 19-inch cabinet.

Figure 3-2 Appearance of a 19-inch cabinet

3.2.1.2 Dimensions

The dimensions of a 19-inch cabinet are as follows in terms of Height (H)×Width (W)×Depth (D):

- 2000mm×600mm×600mm
- 2200mm×600mm×600mm
- 2600mm×600mm×600mm

3.2.1.3 Equipment Layout

This section introduces the equipment layout in a 19-inch cabinet.

See Figure 3-3 for typical layout in a 19-inch cabinet.

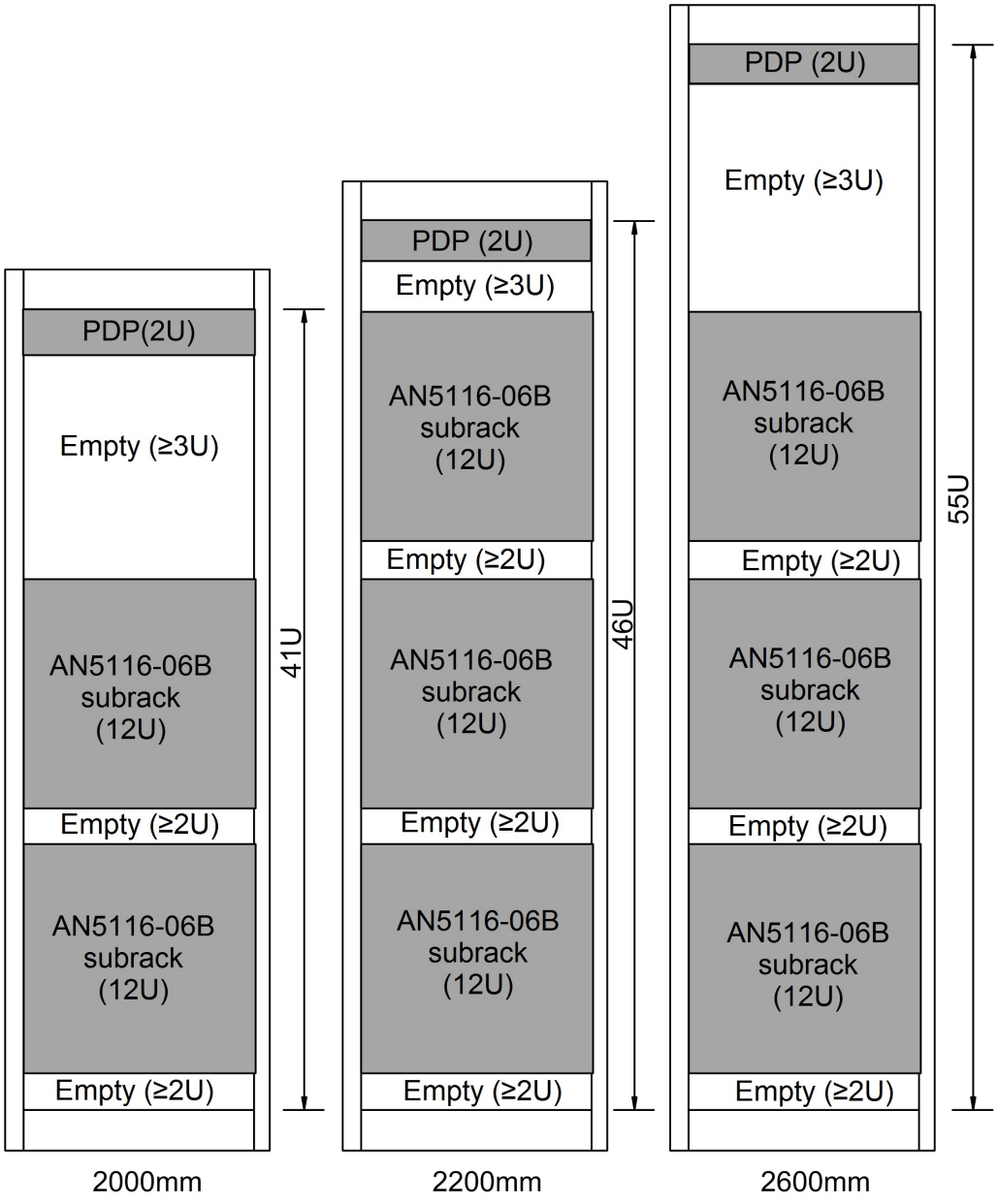


Figure 3-3 Typical layout of a 19-inch cabinet

Note:

If the cabinet is not fully configured, you should arrange the subracks from bottom up and reserve the upper space for capacity expansion in the future.

3.2.2 21-inch Cabinet

This section introduces the 21-inch cabinet used by the AN5116-06B.

3.2.2.1 Appearance

This section introduces the appearance of the 21-inch cabinet.

See Figure 3-4 for the appearance of the 21-inch cabinet.

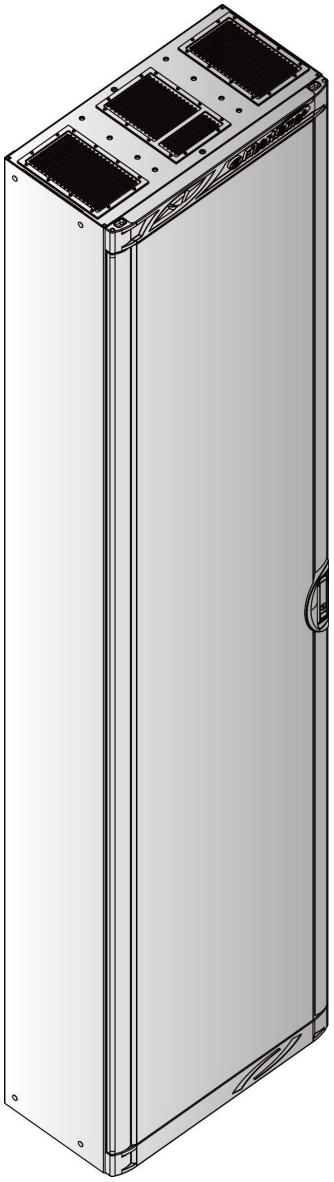


Figure 3-4 Appearance of a 21-inch cabinet

3.2.2.2 Dimensions

The dimensions of a 21-inch cabinet are as follows in terms of Height (H)×Width (W)×Depth (D):

- 2000mm×600mm×300mm
- 2200mm×600mm×300mm
- 2600mm×600mm×300mm

3.2.2.3 Equipment Layout

This section introduces the equipment layout in a 21-inch cabinet.

See Figure 3-5 for typical layout in a 21-inch cabinet.

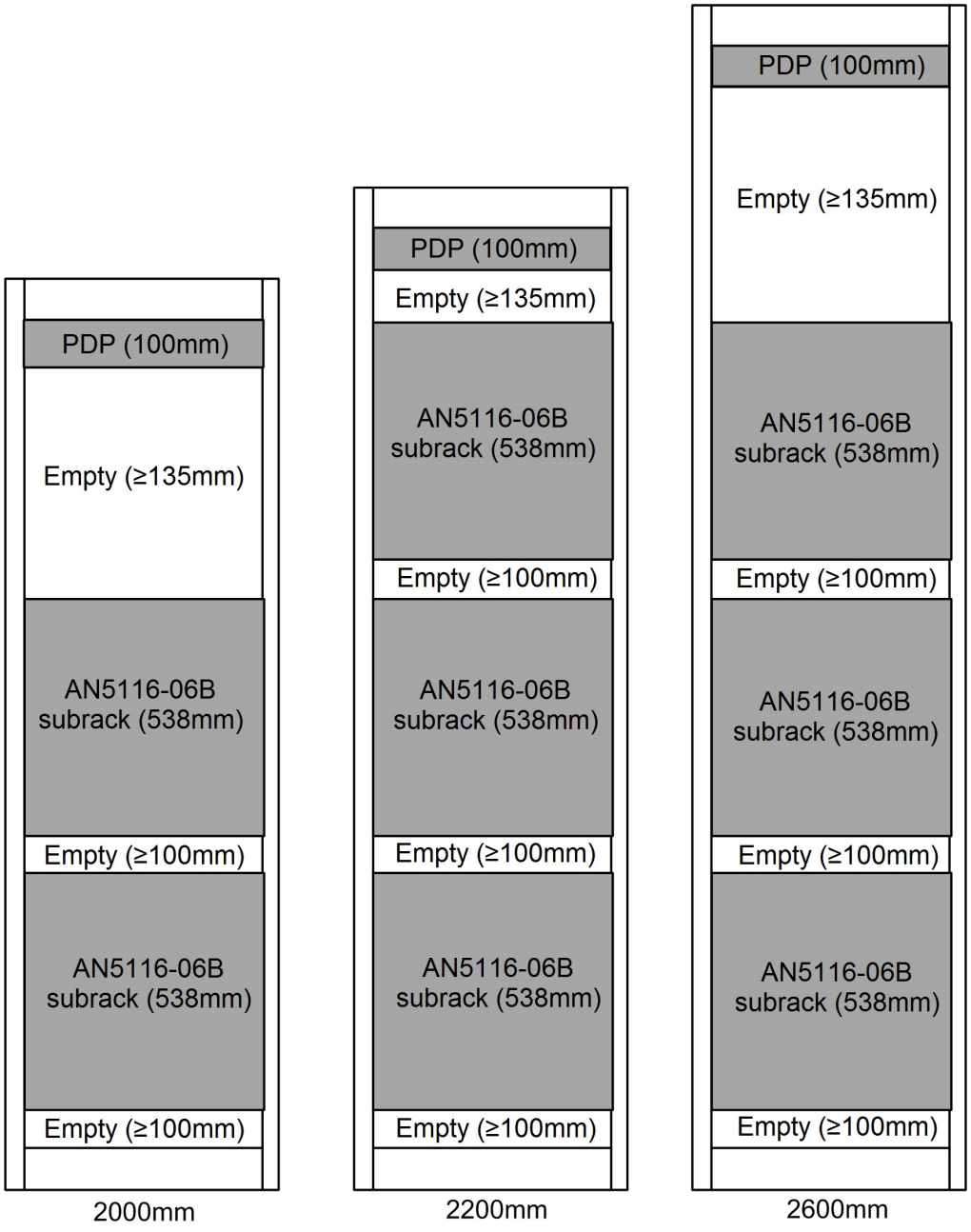


Figure 3-5 Typical layout of a 21-inch cabinet

Note:

If the cabinet is not fully configured, you should arrange the subracks from bottom up and reserve the upper space for capacity expansion in the future.

3.2.3 PDP

The AN5116-06B uses PDP296B, a dual-power PDP that has functions such as power distribution, alarm signal processing, lightning protection, and protection against reverse polarity connection.

Note:

By using different mounting ears, the PDP296B can be mounted in a 600mm deep 19-inch cabinet or a 300mm deep 21-inch cabinet.

The correspondence between cabinets and extension numbers of the PDP are as follows:

- For a 21-inch cabinet with front vertical mounting flanges, the PDP extension number is 3000068-2FAR1A.
- For a 21-inch cabinet with rear vertical mounting flanges, the PDP extension number is 3000068-2BAR1A.
- For a 19-inch cabinet with front vertical mounting flanges, the PDP extension number is 3000068-1FAR1A.

3.2.3.1 Function

This section introduces the functions of the PDP.

The PDP is used to perform the following functions:

- Inducts two channels of DC -48V power (active and standby) from the external (e.g. the power cabinet) and provides three sets of redundant branch power rails (six branch power rails total) for the three subracks.
- Performs the lightning protection function. The PDP can effectively withstands surge currents of common mode 2kV (1.2/50us to 8/20us hybrid wave) and differential mode 1kV (1.2/50us to 8/20us hybrid wave) on the power line.

- Performs the alarm input and output function: The PDP collects the alarm information from corresponding equipment in the cabinet, provides audible and visual display of the alarm signals, and outputs the alarm signals to higher-level equipment (such as the head of row cabinet).

3.2.3.2 Appearance

This section introduces the appearance of the PDP.

See Figure 3-6 for the appearance of the PDP296B.

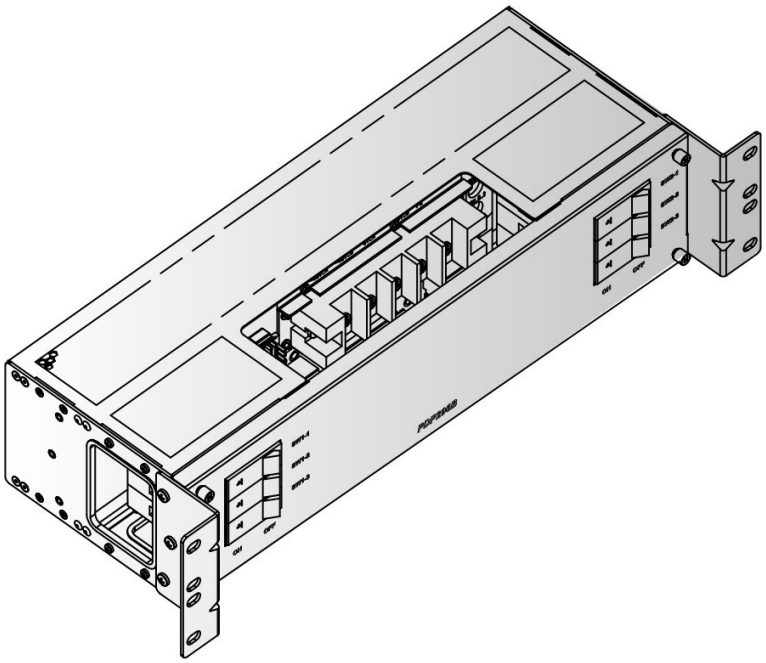


Figure 3-6 Appearance of the PDP296B

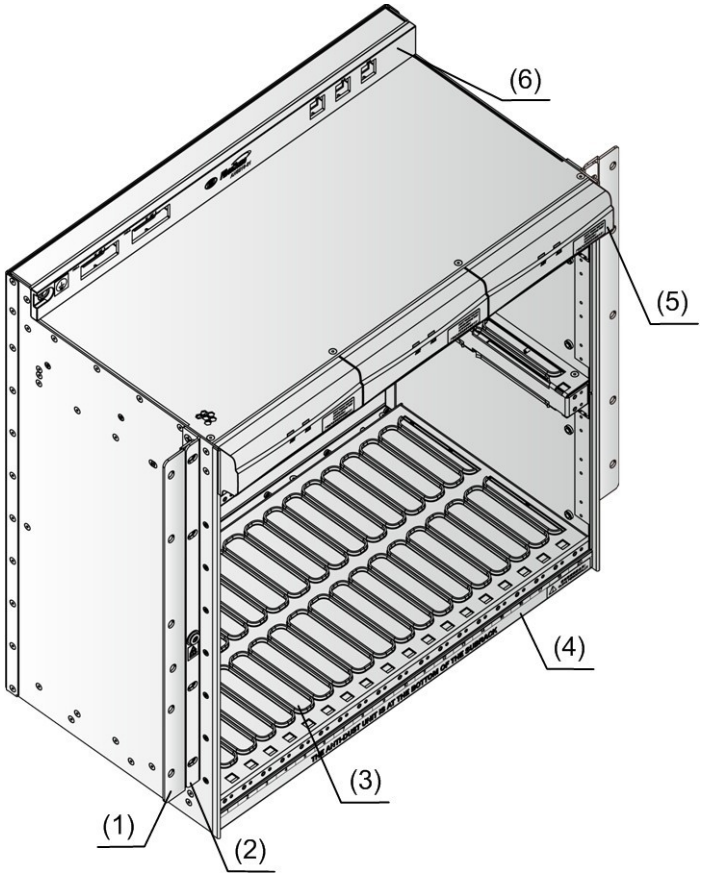
3.2.4 Subrack

This section introduces the appearance, structure and layout of the subrack.

3.2.4.1 Appearance

This section introduces the appearance and structure of the subrack.

The backplane of the AN5116-06B is located in the rear of the subrack. All cards of the equipment are plugged from the front of the subrack and front wiring mode is used. Figure 3-7 shows the structure and components of the subrack.



(1) Mounting ear (2) Adaptor mounting ear (3) Card area

(4) Anti-dust screen (5) Fan unit (6) Backplane

Figure 3-7 Subrack structure

See Table 3-1 for description of each component of the subrack.

Table 3-1 Description of subrack structure

Number	Description	Function
(1)	Mounting ear	Secures the subrack in the 19-inch cabinet.
(2)	Adaptor mounting ear	Secures the subrack in the 21-inch cabinet.
(3)	Card area	Holds the various cards to implement different functions of the equipment.
(4)	Anti-dust screen	Prevents dust from entering the subrack.

Table 3-1 Description of subrack structure (Continued)

Number	Description	Function
(5)	Fan unit	Facilitates air cooling for the equipment.
(6)	Backplane	Connects each module and performs the function of bus.

3.2.4.2 Slot Allocation and Typical Configuration

See Figure 3-8 for the slot allocation and typical configuration of the subrack.

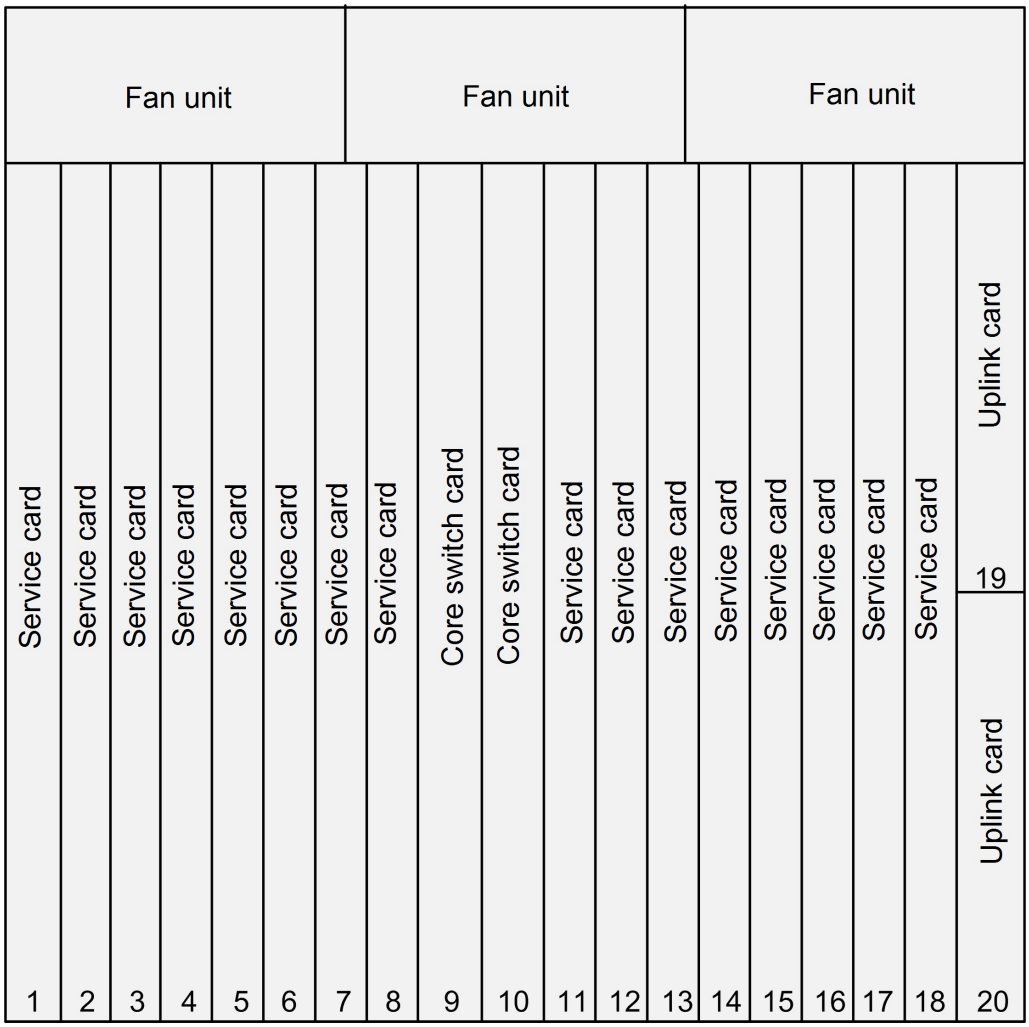


Figure 3-8 Slot allocation and typical configuration of the subrack

The AN5116-06B subrack has a total of 20 vertical slots.

- Slots 1 to 8 and 11 to 18 hold various service cards such as EPON interface cards, 10G EPON interface cards, GPON interface cards, TDM interface cards, and public cards.
- Slots 9 and 10 in the middle are slightly wider and hold the core switch cards.
- Slots 19 and 20 are on the right side of the subrack. Half as high as other slots, these two slots are designed for uplink cards.

3.2.5 Card

See Table 3-2 for the AN5116–06B card functions.

Table 3-2 The AN5116-06B card function list

Card Type	Abbre-viation	Card Number	Function Description
Uplink card	HU1A	2.170.846	Terminates the provider network uplink signals; provides four GE and one 10GE uplink optical interfaces.
	HU2A	2.170.854	Terminates the provider network uplink signals; provides two GE and two 10GE uplink optical interfaces.
	GU6F	2.170.855	Terminates the provider network uplink signals; provides six GE uplink optical interfaces.
EPON interface card	EC4B	2.119.318	Terminates the subscriber EPON service access; provides four EPON service interfaces. Supports 1:64 split ratio within the limits of the optical power budget.
	EC8B	2.119.354	Terminates the subscriber EPON service access; provides eight EPON service interfaces. Supports 1:64 split ratio within the limits of the optical power budget.
10G EPON interface card	XG2B	2.119.376	Terminates the subscriber 10G EPON service access; provides two 10G EPON service interfaces. Supports 1:128 split ratio within the limits of the optical power budget.
GPON interface card	GC4B	2.119.348	Terminates the subscriber GPON service access; provides four GPON service interfaces. Supports 1:128 split ratio within the limits of the optical power budget.
	GC8B	2.200.012	Terminates the subscriber GPON service access; provides eight GPON service interfaces. Supports 1:128 split ratio within the limits of the optical power budget.
TDM interface card	CE1B	2.170.845	Terminates the TDM service uplink signals; provides 32 E1 interfaces.

Table 3-2 The AN5116-06B card function list (Continued)

Card Type	Abbre-viation	Card Number	Function Description
	C155A	2.170.821	Terminates the TDM service uplink signals; provides one STM-1 optical interface.
Public card	PUBA	2.167.177	Provides 14 dry-contact interfaces.
Core switch card	HSWA	2.115.334	Furnishes system traffic flow convergence functions in EPON systems; including L2 switching, processing of higher layer protocols, and fault diagnosis. Supplies configuration management and performance management for the entire subrack. Provides one Console local management interface.
	HSWA	2.115.331	Furnishes system traffic flow convergence functions in GPON systems; including L2 switching, processing of higher layer protocols, and fault diagnosis. Supplies configuration management and performance management for the entire subrack. Provides one Console local management interface.
Fan card	FCB	2.119.295	Provides fans to cool the equipment and regulate internal system temperature.

3.3 Software Architecture

The AN5116-06B's system software is composed of the core switching software and the line card software.

- The core switching software executes on the core switch card. It manages and maintains the AN5116-06B, and supports the network management system interface for management and maintenance purposes.
- The line card software executes on the various service interface cards and communicates with the core switching software via a dedicated bus in the backplane.

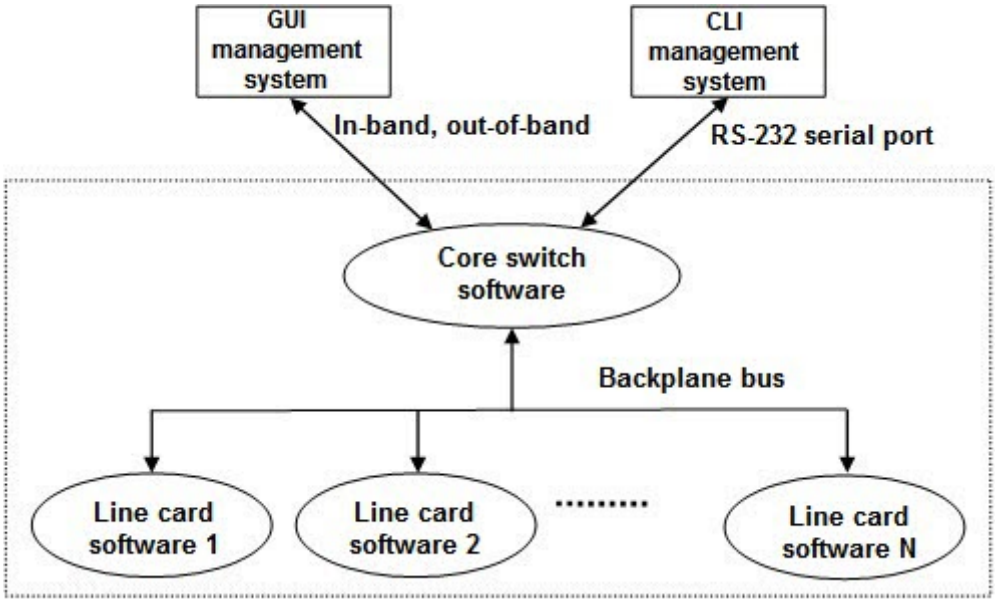


Figure 3-9 The AN5116-06B system software architecture

4 System Management

This chapter introduces how to manage the AN5116-06B via the ANM2000. It includes the following contents:

- ☑ Management Modes
- ☑ CLI Network Management System
- ☑ ANM2000

4.1 Management Modes

The AN5116-06B has an extremely flexible management system and includes various modes for equipment maintenance and monitoring. The various modes are described below:

- The location of the network management system can be classified as local and remote management (Telnet) mode.
  - In local management mode, the network management system computer or server is directly connected with the managed equipment via its network management interface. The AN5116-06B's console port is the typical port used for local management mode.
  - In remote management mode, the network management system computer or server is connected with the equipment via a serial interface using the telnet protocol. The AN5116-06B's GE and 10GE uplink ports are typical ports used for remote management mode.
- The management transport modes can be classified as in-band mode and out-of-band mode.
  - When using out-of-band mode, the management information is transported via an independent physical path and does not use the subscriber service path. The management information is fully independent of service information and there is no interaction between them. When the service path fails, the out-of-band mode network management path is still functional and the management system can isolate the equipment fault and monitor the equipment in real time.
  - When using in-band mode, the management information is transported via the subscriber service path provided by the managed equipment. The in-band mode is featured by easy networking. However, it has a disadvantage in that the network management system cannot maintain and monitor the managed equipment in the event of a service path failure.
- The network management system user interface can be classified as GUI (Graphical User Interface) mode or CLI (Command Line Interface) mode.

- The CLI mode executes various commands composed of character strings entered via a telnet interface using a PC, typically using a Windows operating system. The CLI needs no customer software installation and is easy to operate. Operators can login the CLI network management system via the Console interface of the HSWA card or the Telnet terminal. The disadvantage of this mode is that all commands must be input line-by-line in text mode. This may be too complex for the casual or occasional operators.
- The GUI mode provides graphical interfaces for operators and uses a mouse for “point and click” operation. It is easy to understand and operate. Compared with the CLI mode, the GUI mode simplifies the man-machine interface and is easier for operators to master with less training.

4.2 CLI Network Management System

Operators can login the CLI management system for the AN5116-06B in either of the two ways as mentioned below:

- Log in the AN5116-06B system via the Console interface using a hyper terminal.
- Log in the AN5116-06B system via the uplink interface or out-of-band network port in Telnet mode.

Figure 4-1 illustrates the network diagram for logging in the CLI network management system.

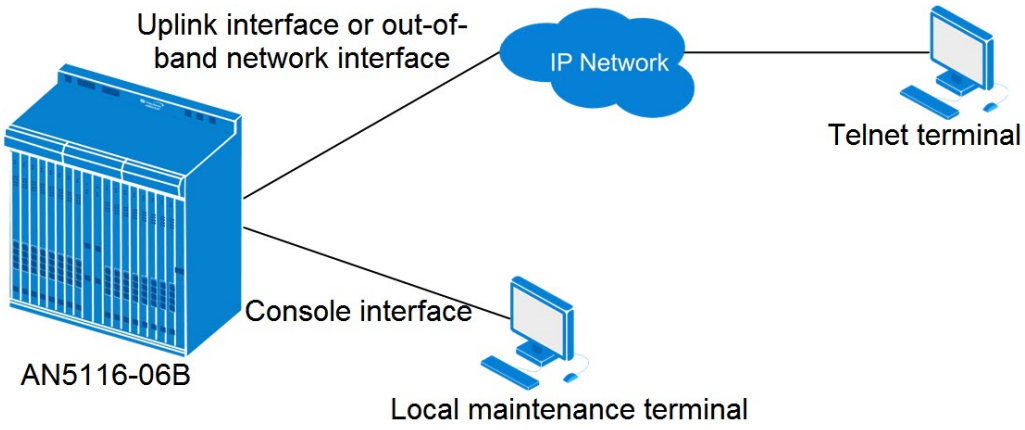


Figure 4-1 Network diagram for the CLI network management system

4.3 ANM2000

The ANM2000 is developed by FiberHome independently. It is a GUI network management system for access network products. The ANM2000 performs management of various NE equipment, and can satisfy varied demands of operators well in network management.

The ANM2000 runs on the Windows NT operating system. With a graphical user interface, it is more visual and user friendly. The features of the ANM2000's are described below.

- The ANM2000 is a universal network management system platform for all FiberHome access products. Its communication protocols and management functions comply with the relevant industry standards.
- The ANM2000 uses a hierarchical structure and an object-oriented design. The software architecture of the system facilitates adding and extending management objects and is easy to operate. This helps minimize maintenance costs.
- The ANM2000 uses an open system structure that makes management layers independent of each other. The system executes in an object-oriented concurrent multitasking manner.
- The ANM2000 supports concentrated remote management. When the size of the managed network is increased, operators can easily add the new network elements without impacting the performance of the network management system.
- The ANM2000 supports performance management, fault management and configuration management, monitoring the managed network elements in real time.
- The ANM2000 provides reliable security precautions. The system verifies all users and operating objects based on different security levels.
- The ANM2000 provides standard SNMP uplink / downlink ports and can manage the access products of FiberHome that have SNMP compliant network management interfaces.

4.3.1 Function

The ANM2000 network management system possesses four major functions; configuration management, fault management, performance management and security management.

It can act as network management system proxy to conduct remote management of ONUs connected with the AN5116-06B in compliance with the IEEE802.3 Ethernet OAM standard.

Topology Management

The ANM2000 can display the topology of the managed network. Topology management simplifies network operations and reduces the maintenance workload.

- All central OLT equipment, OLT cards, ONU equipment and ONU interfaces are displayed in the topology view.
- The status of the managed objects can be shown dynamically and in real time in the topology display.
- Operators can retrieve configuration information and execute relevant configuration commands by clicking each topology icon.
- They also can add, delete, modify, move or hide objects in the topology view.

Configuration Management

The ANM2000 possesses a diverse set of configuration processing functions which are listed as below.

- The ANM2000 consolidates service configurations to facilitate operations.

  Operators can setup data, voice and CATV services in a single network management system GUI. This improves network management system operation convenience and efficiency.

- The management system verifies the validity of configuration data.

  The system will check whether the input configuration data is correct, and whether this data is in conflict with other configured objects. If there is an error, it reports to the operator in real time and creates a log entry.

- The ANM2000 system imports / exports configuration data.

It can export configuration data in the network management system database or the data from the managed core switch cards to a configuration file, so as to enhance network security.

- The management system provides a pre-configure function.

  Before the network management system is connected with the AN5116-06B, operators can configure the services in network management system database. Once the network management system is connected with the AN5116-06B, the pre-configured data will be immediately delivered to the AN5116-06B and then to the service interface cards, to quickly complete service configuration.

- The ANM2000 audits the configuration data.

  It can check whether the configuration data in the network management system database is consistent with the data in the managed equipment. The network management system GUI will list the inconsistent items.

- The ANM2000 uploads / downloads configuration data.

  It supports uploading / downloading of configuration data in case of inconsistency in configuration data between the network management system and the managed equipment. The configuration data can be uploaded from the equipment to the management system or downloaded from the management system to the equipment.

Fault Management

The ANM2000 network management system supervises the alarm data of all equipment in the network. It helps to locate and eliminate faults quickly, and helps to ensure the normal operation of the network.

- Locates alarms to a single port, so as to simplify troubleshooting.
- Each alarm has additional alarm information, which helps maintenance personnel analyze, locate and remove faults as fast as possible.
- Configures threshold values for OLT and ONU optical modules' parameters.
- Monitors OLT and ONU optical modules' parameters. When a parameter exceeds the threshold set for it, an alarm will be produced.
- Supports system performance testing.

Performs continuous or on command testing, observation and monitoring of each part of the system. This ensures early fault detection and prevents degradation of equipment performance.

- After a fault is removed, the corresponding alarm in the network management system will be cleared automatically.
- Supports alarm reporting list with detailed information.

  The alarm reporting list enumerates types, levels, reasons and time range of all faults. This facilitates subsequent processing by maintenance engineers.
- Supports filtering current alarms according to the level and type.
- Provides loopback testing of the E1 interface on both the OLT TDM card and ONU UNI allowing the maintenance engineer to quickly locate line faults.
- Provides signaling tracing for voice service.

  Traces and analyzes all interactive signaling between the IAD and the softswitch platform. This facilitates analyzing abnormal call signaling patterns.
- Provides analogue line testing function for POTS interfaces.

  When the service provider enables the inner / outer line testing function from the network management system, the equipment will automatically run inner / outer line testing and report the results to the network management system, so as to facilitate identification of faults.

Performance Management

The ANM2000 provides performance monitoring and traffic statistics for all equipment in the network. This allows the operator to trace and analyze equipment performance, and properly allocate resources.

- Supports periodic performance parameter collection in 15 minutes and 24 hours.

  Performance statistics for Ethernet data is collected on each interface, including uplink interfaces, PON interfaces and ONU’s subscriber-side interfaces.
- Monitors the optical transceiver parameters at both the OLT and the ONU.

  Both the transmit and the receive optical power are monitored. In the OLT the receive burst optical power is monitored for each ONU.

- Sets Ethernet data performance thresholds.

  When the monitored parameter crosses the threshold, an alarm will be generated.

- Views real-time performance and history performance.
- Manages history performance and history alarm reports, so as to help maintenance engineers manage data collected.

Security Management

The ANM2000 verifies the login authority of each operator that uses the network management system. This prevents unauthorized operators from viewing and configuring network resources / equipment and helps guarantee the security of the managed network.

- Supports setting management permissions for each operator.

  When an operator logs into the network management system, the system verifies their account permissions, so as to avoid use by unauthorized operators, and it also sets different management permissions to restrict actions of the logged-in operators thus ensuring the operational security of the network management system and the managed network.

- Supports management within a specific domain or geographical area.

  The network management system restricts area management for logged-in operators according to the management requirements. By dividing different areas for management, it guarantees complete and reliable maintenance of the whole system.

Log Management

The network management system provides a flexible and comprehensive log management function. Logs are classified into routine operation logs and automatic upgrade logs. Automatic logs are only created after the automatic upgrade function has been enabled.

- Records information about each operator’s login procedure.

  Records detailed information about each operator’s login procedure, including operator information and login time.

- Records various operations performed by each operator in the network management system.
- Supports permission based access to operating logs.
- Can be searched on each operator, so as to display all actions performed by a specific operator. Each record displays the operator name, operation time and operation type.
- When an unauthorized user attempts to log into the network management system, an alarm will be raised.
- The unauthorized operation attempt will be recorded by the log and given a security prompt.
- The system can saves operation logs to the dedicated peripheral storage device.
- The system supports periodic generation of a multicast log.

  It records the time of each subscriber join / leave for each multicast group. This helps facilitate the management of multicast service.

4.3.2 Operating Environment

This section introduces the operating environment for the AN5116-06B.

Server end

- Hardware configuration: PC server.
- Software configuration: Windows2003 Server SP1 + Informix Dynamic Server 9.4.
- ANM2000 system software: ANM2000 server edition.

Client end

- Hardware configuration: PC.
- Software configuration: Windows2003 Server SP1 / Windows XP Professional SP2
- ANM2000 system software: ANM2000 client edition.

4.3.3 Networking Mode

The ANM2000 network management system performs remote management by SNMP. This SNMP protocol can be transported using either in-band or out-of-band modes.

Out-of-band mode

The AN5116-06B provides a dedicated interface (EMS) for out-of-band network management.

Service data and network management information are transmitted via physically separate hardware circuits. This effectively guarantees an expedited network management channel. The EMS interface is located on the upper part of the AN5116-6B subrack. The out-of-band connection is shown in Figure 4-2.

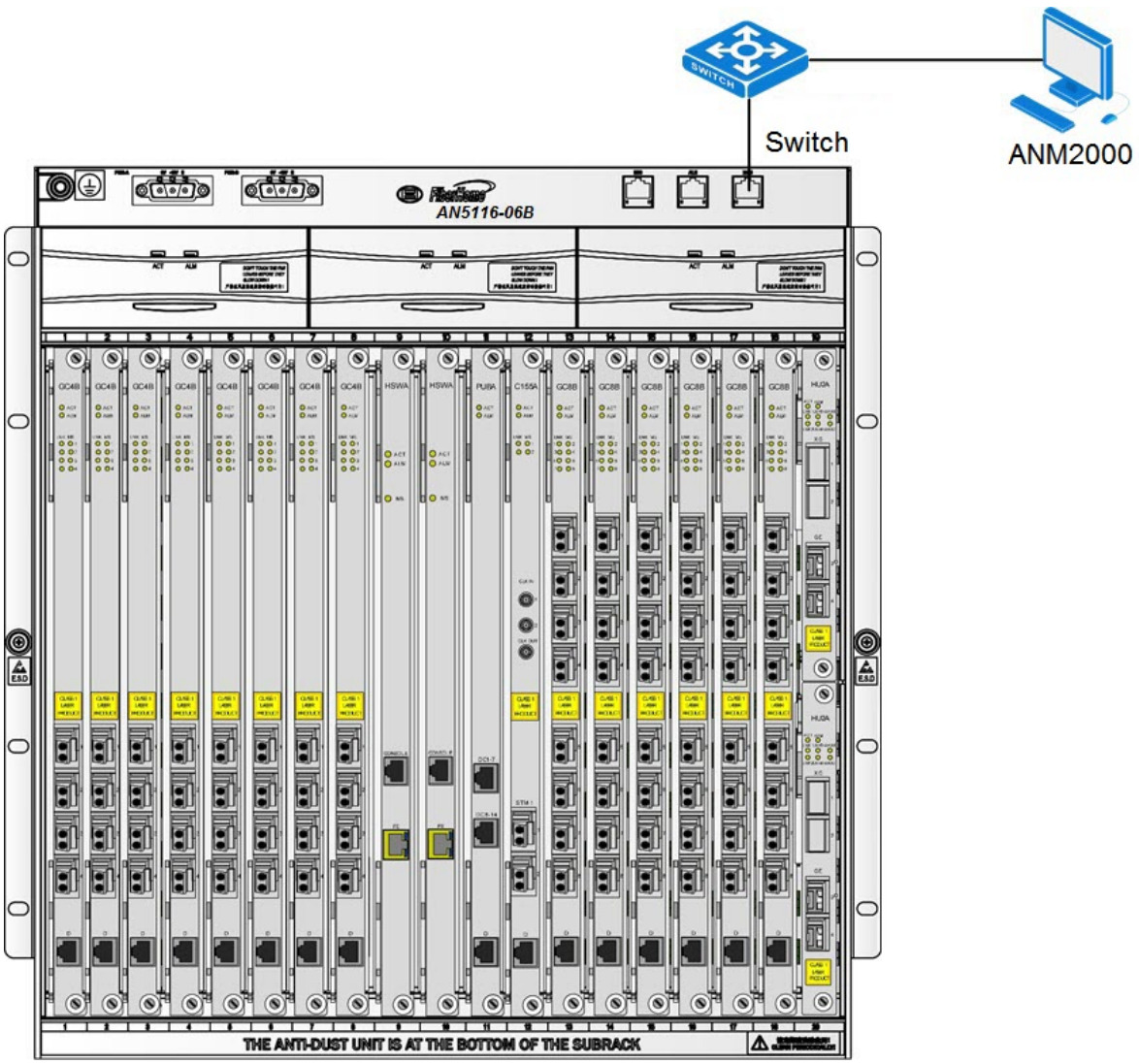


Figure 4-2 The ANM2000 out-of-band networking diagram

In-band mode

All GE and 10GE uplink ports of the AN5116-06B can be used as in-band network management interfaces.

To ensure in-band management information security, the AN5116-06B separates network management information and service information by setting the priority field in the service VLAN to the highest priority for management traffic. The in-band connection is shown in Figure 4-3.

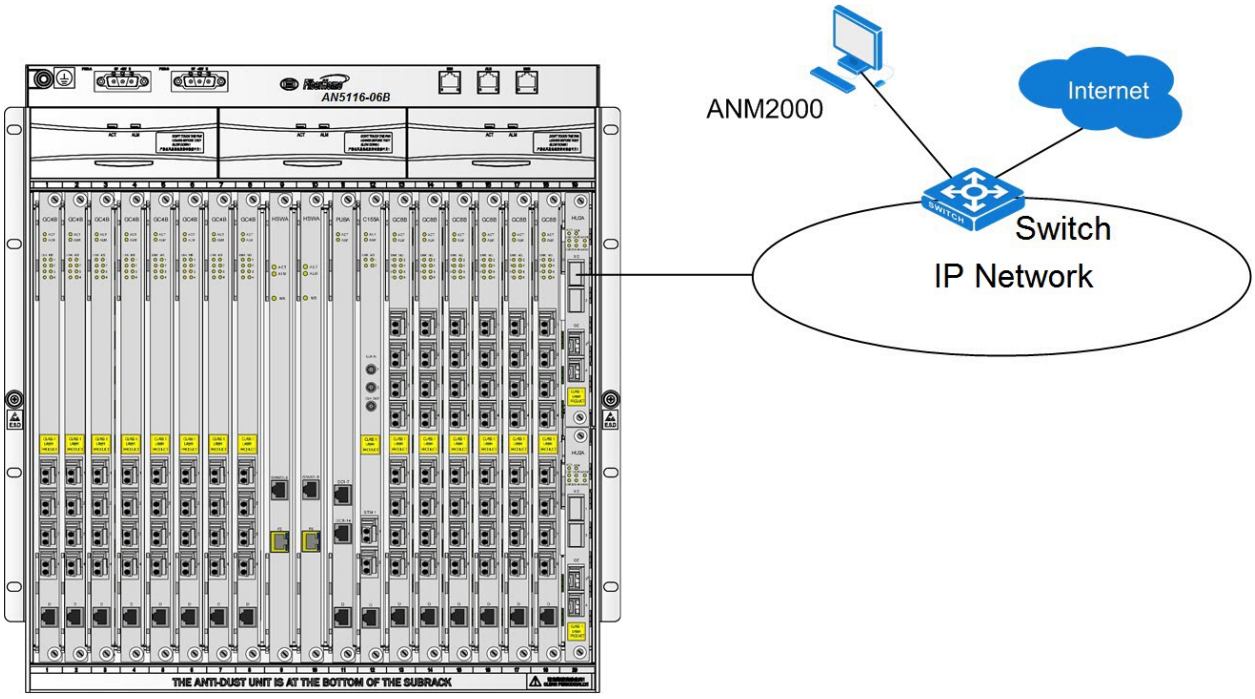


Figure 4-3 The ANM2000 in-band networking diagram

5 Technical Specifications

This chapter lists the AN5116-06B's technical specifications and applicable standards.

- ☑ Performance Parameters
- ☑ Interface specification
- ☑ Mechanical Dimensions and Weight
- ☑ Power Supply and Power Consumption
- ☑ Equipment Room Conditions
- ☑ Standards and Protocols

5.1 Performance Parameters

This section introduces relevant performance parameters of the AN5116-06B.

5.1.1 Overall Performance

Table 5-1 Overall performance of the AN5116–06B

Item	Specification
Core switch card capacity	488Gbit/s
Backplane bus capacity	1Tbit/s
Maximum transmission distance	20km
Maximum split ratio of EPON	1:64
Maximum split ratio of GPON	1:128
Core switch card main / backup switch time	≤50ms
Core switch card main / backup switch time	<50ms
Optical line protection switch time	<200ms

Table 5-2 DBA performance of the AN5116–06B

Item	Specification
Minimum bandwidth allocation granularity	≤64kbit/s
Minimum configurable bandwidth	≥256kbit/s
Accuracy	Better than ±5%

Table 5-3 Ethernet service performance of the AN5116–06B

Item	Specification	
Throughput (EPON)	Uplink throughput: ≥950Mbit/s	
	Downlink throughput	1.25G mode: ≥980Mbit/s
		2.5G mode: ≥1.8Gbit/s
Throughput (GPON)	Uplink throughput: ≥1100Mbit/s	
	Downlink throughput: ≥2400Mbit/s	
Latency	Uplink latency (when traffic flow is no more than 90% of system throughput)<1.5ms	
	Downlink latency (when traffic flow is no more than 90% of system throughput)<1ms	

Table 5-3 Ethernet service performance of the AN5116–06B (Continued)

Item	Specification
Packet loss rate	Uplink overload packet loss rate (uplink and downlink traffic being 1Gbit/s and 2.5Gbit/s respectively): <10%
	Downlink overload packet loss rate (uplink and downlink traffic being 1Gbit/s and 2.5Gbit/s respectively): <5%
Long-term packet loss rate	Under certain traffic flow (90% of throughput), the long-term (24 hours) packet loss rate of Ethernet service is 0.

Table 5-4 Voice service performance of the AN5116–06B

Item	Specification
Voice encoding dynamic switch period	<60ms
Voice interruption and jitter occurrence	0
Objective evaluation of voice	Very good network condition: PSQM average value<1.5
	Bad network condition (packet loss rate=1%, jitter=20ms, delay =100ms): PSQM average value<1.8
	Very bad network condition (packet loss rate=5%, jitter = 60ms, delay = 400ms): PSQM average value<2.0
Subjective evaluation of voice	Very good network condition: MOS>4.0
	Bad network condition (packet loss rate=1%, jitter=20ms, delay=100ms): MOS>3.5
	Very bad network condition (packet loss rate=5%, jitter=60ms, delay=400ms): MOS>3.0
Encoding rate	For G.711: encoding rate=64kbit/s
	For G.729a: encoding rate<18kbit/s
	For G.723.1(5.3): encoding rate<18kbit/s
	For G.723.1(6.3): encoding rate<15kbit/s
Loopback delay	For G.729a: loopback delay<150ms
	For G.723.1: loopback delay<200ms
Call loss rate	Call lost rate<0.01%

Table 5-5 TDM service performance of the AN5116–06B

Item	Specification
Bit error ratio	Under normal condition, BER of E1 path for 24 hours is 0.
Latency (EPON)	Under normal condition, latency from E1 interface to E1 uplink interface of ONU is<1.5ms.
Latency (GPON)	Under normal condition, latency from E1 interface to E1 uplink interface of ONU is<1.5ms.
Jitter transmission features	When 0Hz≤f≤40Hz, gain=0.5dB.
	When 40Hz≤f≤400Hz, gain decreases as frequency increases.
	When f≥400Hz, gain=-19.5dB.
Transmitting optical power	The range of average transmission optical power of STM-1 optical interface: -8 to -15dBm.
Input interface receiving sensitivity	Input interface receiving sensitivity of STM-1 optical interface≤-31dBm.
Input interface overload optical power	Input interface overload optical power of STM-1 optical interface≥-8dBm.
Input allowable frequency offset	Input allowable frequency offset of STM-1 optical interface≥±20ppm.

5.1.2 Access Capability

Table 5-6 Access capacity of the AN5116–06B

Item	Specification
Maximum quantity of PON interfaces for single subrack	128 PON interfaces
Maximum quantity of terminal subscriber interfaces for single subrack	8000 terminal subscriber interfaces
Maximum quantity of uplink ports for single subrack	Two 10GE optical interfaces + eight GE optical interfaces (HU1A)
	Four 10GE optical interfaces + four GE optical interfaces (HU1A)
	12 GE optical interfaces (GU6F)
Maximum quantity of STM-1 optical interfaces for single subrack	Two STM-1 optical interfaces (1+1 protection)
Maximum quantity of E1 interfaces for single subrack	64 E1 interfaces

5.1.3 Service Features

Table 5-7 Service features and specifications of the AN5116–06B

Item	Specification
Redundancy protection	The core switch card supports 1+1 active / standby switching.
	The uplink card supports 1+1 active / standby switching; the uplink interface supports Trunk and dual-homing protection.
	The TDM card supports 1+1 protection.
	The EC4B / GC4B cards supports optical line protection switching, intra-card PON MAC chip-level protection and inter-card PON MAC chip-level protection.
	The power supply supports 1+1 protection.
Layer 2 forwarding	The OLT and ONU support dynamic learning of the MAC address, and can forward uplink / downlink traffic at wire speed.
	The OLT supports data forwarding according to the MAC address.
	Supports configuring the aging time of the MAC addresses for the OLT and ONU.
VLAN	Supports maximally 4000 VLANs based on IEEE 802.1Q for a single subrack.
	Supports QinQ VLAN.
	Supports CoS copy.
	Supports VLAN translation.
Routing	Supports Layer 3 routing and protocols such as RIP, OSPF and VRRP.
Port dynamic trunking	Supports Layer 2 port dynamic trunking and the LACP.
Multicast	Supports IGMP Proxy / Snooping.
	Supports controllable multicast.
	Supports multicast VLAN and cross-VLAN multicast.
	Supports online query and statistics of multicast information.
	Supports CDR of multicast service.
	Supports multicast preview and prejoin.
	Supports minimally 4000 multicast groups.
	Supports limit on the number of multicast groups joined simultaneously.
STP / RSTP / MSTP	Supports IEEE 802.1D, IEEE802.1W and IEEE802.1S.
Port mirroring	Supports ingress and egress mirroring.
	Supports flow mirroring.

Table 5-7 Service features and specifications of the AN5116–06B (Continued)

Item	Specification
Port trunking	Supports IEEE 802.3ad.
	Supports up to six GE trunk groups; up to 12 GE ports can be assigned to a trunk group.
	Supports up to two 10GE trunk groups.
Port isolation	Supports EPON / GPON port isolation.
	Supports uplink port isolation.
Broadcast storm control	Supports port-based broadcast / multicast / unknown packets rate control.
FDB	Supports delivering the uplink card's MAC address to ports.
	Supports delivering the line card's MAC address to PON ports.
	Supports 32k MAC address entries.
Flow control	Supports IEEE 802.3x.
FEC	Supports FEC, improving optical power budget by 3dB.
Encryption	Supports the triple churning algorithm and the AES-128 algorithm.
Service flow classification	Classifies service flows as per source MAC address, destination MAC address, source IP address, VLAN ID, CoS, source IP address, destination IP address, protocol type and port number.
Downlink service rate control	Supports rate control based on service flow and port.
Optical power detection	Supports optical power detection for local and remote EPON / GPON optical modules.
VoIP service	Supports H.248, MGCP and SIP.
	Supports signaling tracing for fault diagnosis.
E1 private line service	Provides TDM service encapsulation via the PWE3 protocol, and supports transparent E1 service.
QoS features (EPON)	Supports uplink port's Ethernet data flow based packet filtering, relocating, flow mirroring, traffic statistics, traffic monitoring, port queue scheduling, port rate limit, priority strategy, and priority translation.
	Differentiates and filters packets as per source MAC address, destination MAC address, Ethernet type, VLAN, CoS, source IP address, destination IP address, IP port and protocol type.
	The OLT supports SP, WRR, and SP+WRR queue scheduling algorithms; each uplink port supports eight CoS queues.
	Supports uplink port traffic shaping.
	Supports uplink port flow-based rate control and flow-based mirroring.

Table 5-7 Service features and specifications of the AN5116–06B (Continued)

Item	Specification
	Supports priority retag and copy.
	Supports ITU-T Y.1291 based QoS.
	Supports bandwidth control, with 1 kbit/s granularity.
	Supports 2760 QoS rules.
	The ONU supports multi-LLID technology; an ONU can support up to eight LLIDs.
QoS features (GPON)	Supports uplink port's Ethernet data flow based packet filtering, relocating, flow mirroring, traffic statistics, traffic monitoring, port queue scheduling, port rate limit, priority strategy, and priority translation.
	Differentiates and Filters packets as per source MAC address, destination MAC address, Ethernet type, VLAN, CoS, source IP address, destination IP address, IP port and protocol type.
	The OLT supports SP, WRR, and SP+WRR queue scheduling algorithms; each uplink port supports eight CoS queues.
	Supports uplink port traffic shaping.
	Supports uplink port flow-based rate control and flow-based mirroring.
	Supports priority retag and copy.
	Supports ITU-T Y.1291 based QoS.
	Supports 1024 QoS rules.
	Supports bandwidth control, with 64 kbit/s granularity.
	Supports flexible QoS and SLA; classifies priority queues as per MAC address, 802.1p priority, 802.1Q VLAN tag, IP ToS, IP address, and TCP / UDP address; supports up to 8 service levels.
	Supports T-CONT service scheduling from type 1 to type 5.
	Supports uplink DBA and SBA.
DHCP	Supports DHCP-Snooping.
	Supports DHCP Option82.
Security characteristics	Each uplink port supports up to 120 ACL rules.
	Supports authenticating ONU based on physical address, logic identifier, logic identifier + password, hybrid authentication 1 (logic identifier + physical address), hybrid authentication 2 (logic identifier + password + physical address).
	Supports blocking packets based on MAC address.
	Supports packet filtering or port binding as per source MAC address, destination MAC address, Ethernet type, VLAN, CoS, source IP address, destination IP address, IP port and protocol type.

Table 5-7 Service features and specifications of the AN5116–06B (Continued)

Item	Specification
	Supports protection against DoS attacks.
	Supports limit on maximum number of MAC addresses learnt, so as to avoid attacks on subscribers' MAC addresses.
Clock recovery mode	Supports recovering TDM service clock in four modes: adaptive clock recovery , enhanced adaptive clock recovery, differential clock recovery and loopback clock recovery.
System clock mode	Supports deriving system clock from multiple ways such as the internal free running clock, external clock interface, and physical layer of the service link.

5.1.4 Reliability Specifications

See Table 5-8 for the AN5116-06B card reliability specifications; see Table 5-9 for equipment reliability specifications.

Table 5-8 The AN5116-06B card reliability specifications

Card	MTBF (hour)	MTBF (hour)	Failure Rate (ppm)
HSWA	148037.24	16.90	6.755
HU1A	339725.81	38.78	2.944
HU2A	339274.78	38.73	2.947
GU6F	358163.67	40.89	2.792
EC4B	149971.26	17.12	6.668
GC4B	146411.36	16.71	6.830
C155A	147353.56	16.89	6.790
CE1B	143050.78	16.33	6.990
PUBA	308614.79	35.23	3.240
Note 1: MTTR (mean time to repair) for each card is 0.5 hour.			

Table 5-9 The AN5116-06B equipment reliability specifications

Configuration model	MTBF (hour)	MTBF (year)	Failure Rate (ppm)	Availability
IP uplink, 4096 lines	125906.76	14.37	7.942	0.99999205
Note 1: MTTR (mean time to repair) for the whole system is 0.5 hour.				

5.2 Interface specification

This section introduces specifications of the AN5116-06B interfaces.

5.2.1 Specifications of Interfaces on EC4B / EC8B Card

Table 5-10 Specifications of Interfaces on EC4B / EC8B Card

Item		1.25Gbit/s EPON Interface	2.5Gbit/s GPON Interface
Interface type		SC / PC	SC / PC
Transmitter	Nominal bit rate	1.25Gbit/s±100ppm	2.5Gbit/s±100ppm
	Wavelength range	1480nm to 1500nm	1480nm to 1500nm
	Average mean launch power (maximum)	+7 dBm	+4 dBm
	Average mean launch power (minimum)	+2 dBm	0 dBm
	Average launch power-OFF transmitter	-39 dBm	-45 dBm
	Extinction ratio (minimum)	+9dB	+9dB
Receiver	Nominal bit rate	1.25Gbit/s±100ppm	2.5Gbit/s±100ppm
	Wavelength range	1260nm to 1360nm	1275nm to 1340nm
	Receiver sensitivity (maximum)	-27 dBm	-23.5 dBm

5.2.2 Specifications of Interfaces on XG2B Card

Table 5-11 Specifications of interfaces on XG2B card

Item		1.25Gbit/s 10G EPON interface	10Gbit/s 10G EPON interface
Interface Type		SC / PC	SC / PC
Transmitter	Nominal bit rate	1.25Gbit/s±100ppm	10Gbit/s±100ppm
	Wavelength range	1480nm to 1500nm	1574nm to 1580nm
	Average mean launch power (maximum)	+7 dBm	+7 dBm

Table 5-11 Specifications of interfaces on XG2B card (Continued)

Item		1.25Gbit/s 10G EPON interface	10Gbit/s 10G EPON interface
	Average mean launch power (minimum)	+2 dBm	+2 dBm
	Average launch power-OFF transmitter	-42 dBm	-42 dBm
	Extinction ratio (minimum)	+9dB	+6dB
Receiver	Nominal bit rate	1.25Gbit/s±100ppm	10Gbit/s±100ppm
	Wavelength range	1280nm to 1340nm	1260nm to 1280nm
	Receiver sensitivity (maximum)	-30 dBm	-28 dBm

5.2.3 Specifications of Interfaces on GC4B / GC8B Card

Table 5-12 Specifications of interfaces on GC4B / GC8B card—Class B+

Item		Specification
Interface Type		SC / PC
Transmitter	Nominal bit rate	2.5Gbit/s±100ppm
	Wavelength range	1480nm to 1500nm
	Average mean launch power (maximum)	+5.0dB
	Average mean launch power (minimum)	+1.5dB
	Average launch power-OFF transmitter	-39dB
	Extinction ratio (minimum)	+9dB
Receiver	Nominal bit rate	1.25Gbit/s±100ppm
	Wavelength range	1260nm to 1360nm
	Receiver sensitivity (maximum)	-28 dBm

Table 5-13 Specifications of interfaces on GC4B / GC8B card—Class C+

Item		Specification
Interface Type		SC / PC
Transmitter	Nominal bit rate	2.5Gbit/s±100ppm
	Wavelength range	1480nm to 1500nm
	Average mean launch power (maximum)	+7.0dB
	Average mean launch power (minimum)	+3.0dB
	Average launch power-OFF transmitter	-39dB
	Extinction ratio (minimum)	+9dB
Receiver	Nominal bit rate	1.25Gbit/s±100ppm
	Wavelength range	1260nm to 1360nm
	Receiver sensitivity (maximum)	-30 dBm

5.2.4 Specifications of interfaces on HU1A / HU2A Card

Table 5-14 Specifications of Ethernet optical interfaces on HU1A / HU2A card

Item	10000Base-SR	10000Base-LR
Interface type	LC/PC	LC/PC
Interface rate	10000 Mbit/s	10000 Mbit/s
Applicable standard	IEEE 802.3ae	IEEE 802.3ae
Central wavelength	850nm	1310nm
Maximum transmission distance	300m	10km
Maximum launched power	-1 dBm	-1 dBm
Minimum launched power	-6 dBm	-6 dBm
Minimum overload power	0	-1 dBm
Maximum receiving sensitivity	-11 dBm	-14 dBm
Minimum extinction ratio	3dB	6dB

Table 5-15 Specifications of Ethernet electrical interfaces on HU1A / HU2A card

Item	10/100/1000Base-T
Interface type	RJ45
Interface rate	10/100/1000Mbit/s self-adaptive

Table 5-15 Specifications of Ethernet electrical interfaces on HU1A / HU2A card (Continued)

Item	10/100/1000Base-T
Transmission media	CAT-5
Applicable standard	IEEE 802.3-2005
Transmission Distance	100m

5.2.5 Specifications of Interfaces on GU6F Card

Table 5-16 Specifications of Ethernet optical interfaces on GU6F card

Item	1000Base-SX	1000Base-LX
Interface Type	LC/PC	LC/PC
Interface rate	1000 Mbit/s	1000 Mbit/s
Applicable standard	IEEE 802.3z	IEEE 802.3z
Central wavelength	850nm	1310nm
Maximum transmission distance	500m	20km
Maximum launched power	-4 dBm	-3 dBm
Minimum launched power	-9.5 dBm	-11.5 dBm
Minimum overload power	0	-3 dBm
Maximum receiving sensitivity	-17 dBm	-19 dBm
Minimum extinction ratio	9dB	9dB

Table 5-17 Specifications of Ethernet electrical interfaces on GU6F card

Item	10/100/1000Base-T
Interface Type	RJ45
Interface rate	10/100/1000Mbit/s self-adaptive
Transmission media	CAT-5
Applicable standard	IEEE 802.3-2005
Transmission Distance	100m

5.2.6 Specifications of Interfaces on CE1B Card

Table 5-18 Specifications of interfaces on CE1B card

Item	Specification	
Pulse shape	All marks of effective signals comply with pulse mask in Figure 5-1.	
Nominal bit rate	2048kbit/s±50ppm	
Pairs per direction	Outer conductor of input port and output port of coaxial pair is connected to ground.	
Test load impedance	75Ω, resistive	120Ω, resistive
Nominal peak voltage of a mask (pulse)	2.37V	3V
Peak voltage of a space (no pulse)	0 ± 0.237 V	0 ± 0.3V
Nominal pulse width	244 ns	
Ratio of the amplitudes of positive and negative pulses at the centre of the pulse interval	0.95 to 1.05	
Ratio of the widths of positive and negative pulses at the nominal half amplitude	0.95 to 1.05	
Code type	HDB3	

5.2.7 Interface Specification of C155A Card

Table 5-19 Interface specification of C155A card

Item		Specification			
Interface type		SC / PC			
Nominal bit rate		155520 kbit/s			
Code applied		S-1.1	L-1.1		L-1.2
Operating wavelength range		1261nm to 1360nm	1263nm to 1360nm		1480nm to 1580nm
Transmitter at reference point S	Source type	MLM	MLM	SLM	SLM
	Maximum RMS width (s)	7.7nm	3nm	–	–
	Maximum -20 dB width	–	–	1nm	1nm
	Minimum side mode suppression ratio	–	–	30dB	30dB

Table 5-19 Interface specification of C155A card (Continued)

Item		Specification			
	Maximum mean launched power	-8 dBm	0		0
	Minimum mean launched power	-15 dBm	-5 dBm		-5 dBm
	Minimum extinction ratio	8.2dB	10dB		10dB
Optical path between S and R	Attenuation range	0 to 12 dBm	10dB to 28dB		10dB to 28dB
	Maximum dispersion	96ps/nm	246ps/nm	NA	NA
	Minimum optical return loss of cable plant at S, including any connectors	NA	NA		20dB
	Maximum discrete reflectance between S and R	NA	NA		-25dB
Receiver at reference point MPI-R	Minimum sensitivity (BER≤10^{-12})	-28 dBm	-34 dBm		-34 dBm
	Minimum overload (BER≤10^{-12})	-8 dBm	-10 dBm		-10 dBm
	Maximum optical path penalty	1dB	1dB		1dB
	Maximum reflectance of receiver at R	NA	NA		-25

5.2.8 Specification of Interfaces on HSWA Card

Table 5-20 Specification of interfaces on HSWA card

Item	Specification
Interface type	RJ-45
Interface standard	Asynchronous EIA / TIA-232
Rate	9600bit/s

5.3 Mechanical Dimensions and Weight

This section introduces mechanical dimensions and weight of the AN5116-06B.

Table 5-21 Mechanical dimensions and weight of the AN5116-06B

Item	Dimensions (Height×Width×Depth)	Weight (Net)
Cabinet	2600mm×600mm×600mm	137kg
	2200mm×600mm×600mm	120kg
	2000mm×600mm×600mm	115kg
	1600mm×600mm×600mm	94kg
	2600mm×600mm×300mm	76kg
	2200mm×600mm×300mm	66kg
	2000mm×600mm×300mm	61kg
	1600mm×600mm×300mm	51kg
Empty subrack (fans included)	621.5mm×480mm×283mm	30kg
Subrack (fully loaded with cards)	621.5mm×480mm×283mm	60kg

5.4 Power Supply and Power Consumption

This section introduces the power supply for the AN5116-06B and power consumption of cards.

- Power consumption of the AN5116-06B fully loaded with EPON cards: < 600W
- Power consumption of the AN5116-06B fully loaded with GPON cards: < 850W

See the following table for power consumption of all AN5116-06B cards under -48V DC.

Table 5-22 The AN5116-06B card power consumption

Card	Power consumption	Card	Power consumption
HSWA	<40W	GU6F	<10W
EC4B	<40W	C155A	<40W
GC4B	<40W	CE1B	<40W
HU1A	<10W	PUBA	<10W
HU2A	<10W	FCB	<15W

5.5 Equipment Room Conditions

This section introduces requirements on equipment room conditions.

5.5.1 Power Supply

- Equipment room voltage: -48V DC (-40V to -57V)
- The equipment room should be equipped with UPS power supply that runs at least 8 hours continuously.

5.5.2 Working Environment

- Ground bearing of the equipment room: > 600kg/m^2.
- No corrosive and solvent gas, and no dust in the atmosphere; no strong electromagnetic field nearby.
- The dust in the environment should be nonconductive of both electricity and magnetism, and noncorrosive, and dust (diameter>5μm) concentration index: ≤3×10^4 unit/m^3.
- Grounding resistance: < 5 Ω.
- Atmospheric pressure: 86kPa to 106kPa.
- Temperature and relative humidity requirements:
  - Operating temperature: 0℃ to +50℃;
  - Storage temperature: -30℃ to +60℃;
  - Relative humidity: ≤90%.

5.6 Standards and Protocols

This section introduces the standards and protocols that the AN5116-06B should comply with.

5.6.1 Environment Standards

Number	Title
ANSI/UL 94-2006	Tests for Flammability of Plastic Materials for Parts in Devices and Appliances (Proposal dated March 17, 2006)
BS EN 60950-1-2006	Information technology equipment - Safety - General requirements
BS EN 60950-22-2006	Information technology equipment - Safety - Equipment installed outdoors
IEC 60917-1	Modular order for the development of mechanical structures for electronic equipment practices - Part 1: Generic standard
IEC 60917-1-amd1	Amendment 1 - Modular order for the development of mechanical structures for electronic equipment practices - Part 1: Generic standard
IEC 60917-2	Modular order for the development of mechanical structures for electronic equipment practices - Part 2: Sectional specification - Interface co-ordination dimensions for the 25 mm equipment practice
IEC 60917-2-1	Modular order for the development of mechanical structures for electronic equipment practices - Part 2: Sectional specification - Interface co-ordination dimensions for the 25 mm equipment practice - Section1: Detail specification - Dimensions for cabinets and racks
IEC 60917-2-2	Modular order for the development of mechanical structures for electronic equipment practices - Part 2: Sectional specification - Interface co-ordination dimensions for the 25 mm equipment practice - Section 2: Detail specification - Dimensions for subracks, chassis, backplanes, front panels and plug-in units
IEC 60917-2-3	Modular order for the development of mechanical structures for electronic equipment practices - Part 2-3: Sectional specification - Interface co-ordination dimensions for the 25 mm equipment practice - Extended detail specification - Dimensions for subracks, chassis, backplanes, front panels and plug-in units
IEC 60950-22-2005	Information technology equipment - Safety - Part 22: Equipment to be installed outdoors
IEC 61587-1-2007	Mechanical structures for electronic equipment - Tests for IEC 60917 and IEC 60297 - Part 1: Climatic, mechanical tests and safety aspects for cabinets, racks, subracks and chassis
IEC 61587-2-2000	Mechanical structures for electronic equipment - Tests for IEC 60917 and IEC 60297 - Part 2: Seismic tests for cabinets and racks

Number	Title
IEC 61587-3-2006	Mechanical structures for electronic equipment - Tests for IEC 60917 and IEC 60297 - Part 3: Electromagnetic shielding performance tests for cabinets, racks and subracks
UL 94-1996	(Test for flammability of plastic materials for parts in devices and appliances)

5.6.2 Electromagnetic Compatibility Standards

Number	Title
CISPR 22	Information technology equipment –Radio Disturbance characteristics –Limits and methods of measurement
CISPR 24	Information technology equipment –Immunity characteristics– Limits and methods of measurement
EN 300 386	Electromagnetic compatibility and Radio spectrum Matters (ERM); Telecommunication network equipment; Electromagnetic Compatibility (EMC) requirements
EN 55022	Information technology equipment – Radio disturbance characteristics - Limits and methods of measurement
EN 55024	Information technology equipment –Immunity characteristics– Limits and methods of measurement
EN 61000-4-2	Electromagnetic compatibility (EMC)– Part 4–2: Electrostatic discharge immunity test
EN 61000-4-3	Electromagnetic compatibility (EMC)– Part 4 – 3: Testing and measurement techniques-Radiated, radio-frequency, electromagnetic field immunity test
EN 61000-4-4	Electromagnetic compatibility (EMC)–Part 4 –4: Testing and measurement techniques-Electrical fast transient/burst immunity test
EN 61000-4-5	Electromagnetic compatibility (EMC)– Part 4 – 5: Testing and measurement techniques-Radiated, radio-frequency, electromagnetic field immunity test
EN 61000-4-6	Electromagnetic compatibility (EMC) –Part 4– 5: Testing and measurement techniques-Immunity to conducted disturbances, induced by radio-frequency fields
ETSI EN 300132-2	Power supply interface at the input telecommunications equipment; Part 2: Operated by direct current (DC)
ETSI EN 300386 V 1.4.1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Telecommunication network equipment; Electromagnetic Compatibility (EMC) requirements

Number	Title
IEC 61000-4-2	Electromagnetic compatibility (EMC) – Part 4 –2:Testing and measurement techniques-Electrostatic discharge immunity test
IEC 61000-4-3	Electromagnetic compatibility (EMC) – Part 4 – 3: Testing and measurement techniques-Radiated, radio-frequency, electromagnetic field immunity test
IEC 61000-4-4	Electromagnetic compatibility (EMC)–Part 4 –4: Testing and measurement techniques-Electrical fast transient/burst immunity test
IEC 61000-4-5	Electromagnetic compatibility (EMC)– Part4– 5: Testing and measurement techniques-Surge immunity test
IEC 61000-4-6	Electromagnetic compatibility (EMC)–Part 4–6: Testing and measurement techniques-Immunity to conducted disturbances, induced by radio-frequency fields
ITU-T K.20	Resistibility of telecommunication equipment installed in a telecommunications centre to overvoltages and overcurrents
ITU-T K.43	Immunity requirements for telecommunication equipment
ITU-T K.48	EMC requirements for telecommunication equipment –Product family Recommendation

5.6.3 Safety Standards

Number	Title
EN 60825-1	Safety of laser products–Part 1 : Equipment classification and requirements
EN 60825-2	Safety of laser products–Part 2 : Safety of optical fiber communication
EN 60950-1	Information technology equipment –Safety–Part 1:General Requirements
IEC 60825-1	Safety of laser products–Part 1 : Equipment classification and requirements
IEC 60825-2	Safety of laser products–Part 2 : Safety of optical fiber communication
IEC 60950-2001	Safety of Information technology equipment including Electrical Business Equipment
UL 60950-1:2003	Information Technology Equipment –Safety –Part 1:General Requirements

5.6.4 EPON Standards

Number	Title
DSL Forum TR-069	CPE WAN Management Protocol
DSL Forum WT-142	Framework for TR-069 enabled PON devices (Revision 3)
IEEE 802.3-2005	IEEE Standard for Information technology–Telecommunications and information exchange between systems–Local and metropolitan area networks– Specific requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications
ITU-T G.983.1	Broadband optical access systems based on Passive Optical Networks (PON)
ITU-T G.983.2	ONT management and control interface specification for B-PON
ITU-T G.983.3	A broadband optical access system with increased service capability by wavelength allocation
ITU-T G.983.4	A broadband optical access system with increased service capability using dynamic bandwidth assignment
ITU-T G.983.5	A broadband optical access system with enhanced survivability
ITU-T G.983.6	ONT management and control interface specifications for B-PON system with protection features
ITU-T G.983.7	ONT management and control interface specification for dynamic bandwidth assignment (DBA) B-PON system
ITU-T G.983.8	B-PON OMCI support for IP, ISDN, video, VLAN tagging, VC cross–connections and other select functions
ITU-T G.983.9	B-PON ONT management and control interface (OMCI) support for wireless Local Area Network interfaces
ITU-T G.983.10	B-PON ONT management and control interface (OMCI) support for Digital Subscriber Line interfaces
ITU-T G.Imp 983.2	Implementers' Guide for ITU-T Rec. G.983.2 (07/2005)

5.6.5 GPON Standards

Number	Title
ITU-T G.984.1	Gigabit-capable passive optical networks (GPON): General characteristics
ITU-T G.984.2	Gigabit-capable Passive Optical Networks (GPON): Physical Media Dependent (PMD) layer specification
ITU-T G.984.3	Gigabit-capable Passive Optical Networks (G-PON): Transmission convergence layer specification

Number	Title
ITU-T G.Imp984.3	Implementers' Guide for ITU-T Rec. G.984.3 (02/2004)
ITU-T G.984.4	Gigabit-capable passive optical networks (G-PON): ONT management and control interface specification
ITU-T G.Imp.984.4	Implementor's Guide for ITU-T Rec. G.984.4
ITU-T G.984.5	Enhancement band for gigabit capable optical access networks
ITU-T G.984.6	Gigabit-capable passive optical networks (GPON): Reach extension

5.6.6 Ethernet Protocols

Number	Title
IEEE 802-2001	IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture
IEEE 802.1ad	IEEE Standard for Local and Metropolitan Area Networks–Virtual Bridged Local Area Networks–Amendment 4: Provider Bridges
IEEE802.1ag-2007	IEEE Standard for Local and Metropolitan Area Networks Virtual Bridged Local Area Networks Amendment 5: Connectivity Fault Management
IEEE 802.1w-2001	Local and metropolitan area networks - Common specifications - Part 3: Media access control (MAC) bridges; Amendment 2: Rapid reconfiguration
IEEE 802.1x-2004	IEEE Standard for Local and Metropolitan Area Networks Port-Based Network Access Control
IEEE 802.1D-2004	IEEE Standard for Local and metropolitan area networks: Media Access Control (MAC) Bridges
IEEE 802.1Q-2005	IEEE Standard for Local and Metropolitan Area Networks–Virtual Bridged Local Area Networks–Amendment 4: Provider Bridges
ITU-T Y.1291	An architectural framework for support of Quality of Service in packet networks
ITU-T Y.1730	Requirements for OAM functions in Ethernet-based networks and Ethernet services
TR-101	Migration to Ethernet-Based DSL Aggregation

5.6.7 Routing Protocols

Number	Title
IETF RFC 2362	Protocol Independent Multicast-Sparse Mode
IETF RFC 1723	RIP Version 2 Carrying Additional Information
IETF RFC 2453	RIP Version 2

5.6.8 NGN Protocols

Number	Title
IETF RFC 3435	RFC 3435-Media Gateway Control Protocol (MGCP) Version 1.0
ITU-T G.711	Pulse code modulation (PCM) of voice frequencies
ITU-T G.711.1	Wideband embedded extension for G.711 pulse code modulation
ITU-T G.723.1	Dual rate speech coder for multimedia communications transmitting at 5.3 and 6.3 kbit/s
ITU-T G.729	Coding of speech at 8 kbit/s using conjugate-structure algebraic-code-excited linear prediction (CS-ACELP)
ITU-T G.729.1	G.729 based Embedded Variable bit-rate coder: An 8-32 kbit/s scalable wideband coder bitstream interoperable with G.729
ITU-T G.Imp 729	Implementers' Guide for G.729 Annexes B, F, G, I and C+ (Coding of speech at 8 kbit/s using CS-ACELP)

5.6.9 Multicast Protocols

Number	Title
IETF RFC 1112	Host Extensions or IP Multicasting
IETF RFC 2236	Internet Group Management Protocol, Version 2
IETF RFC 3376	Internet Group Management Protocol, Version 3

5.6.10 TDM Service Standards

Number	Title
IETF RFC3985 (2005)	PWE3 Architecture
IETF RFC4197 (2005)	Requirements for Edge-to-Edge Emulation of Time Division Multiplexed (TDM) Circuits over Packet Switching Networks

Number	Title
IETF RFC4553 (2006)	Structure-Agnostic Time Division Multiplexing (TDM) over Packet (SAToP)
ITU-T G.703	Physical/electrical characteristics of hierarchical digital interfaces
ITU-T G.812	Timing requirements of slave clocks suitable for use as node clocks in synchronization networks
ITU-T G.813	Timing characteristics of SDH equipment slave clocks (SEC)
ITU-T G.823	The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy
ITU-T G.824	The control of jitter and wander within digital networks which are based on the 1544 kbit/s hierarchy
ITU-T G.8261	Timing and synchronization aspects in packet networks
Telcordia GR-1244-CORE/GR-253	Clocks for the Synchronized Network: Common Generic Criteria

5.6.11 Time Standards

Number	Title
IEEE 1588	Precise Time Synchronization as the Basis for Real Time Applications in Automation
IETF RFC 1305	Network Time Protocol (Version 3) Specification, Implementation and Analysis
IETF RFC 2030	Simple Network Time Protocol (SNTP) Version 4 for IPv4, IPv6 and OSI

5.6.12 Other Standards and Protocols

Number	Title
IETF RFC 2284	PPP Extensible Authentication Protocol (EAP)
SFF-8472	Specification for Diagnostic Monitoring Interface for Optical Transceivers (Rev 10.3 Dec.1, 2007)

Appendix A Abbreviations

ACL	Access Control List
ARP	Address Resolution Protocol
ARPU	Average Revenue Per User
BRAS	Broadband Remote Access Server
CATV	Cable Antenna Television
CLI	Command Line Interface
CoS	Class of Service
DHCP	Dynamic Host Configuration Protocol
DSL	Digital Subscriber Line
DSLAM	Digital Subscriber Line Access Multiplexer
EMC	Electro Magnetic Compatibility
EPON	Ethernet Passive Optical Network
EPON	Ethernet Passive Optical Network
FDB	Forwarding Database
FTTB	Fiber To The Building
FTTH	Fiber To The Home
FTTO	Fiber To The Office
GPON	Gigabit-capable Passive Optical Network
GUI	Graphical User Interface
IGMP	Internet Group Management Protocol
IP	Internet Protocol
LAN	Local Area Network
MAC	Medium Access Control
MGC	Media Gateway Controller
MGCP	Media Gateway Control Protocol
MTBF	Mean Time Between Failure
NGN	Next Generation Network
OAM	Operation, Administration And Maintenance
ODN	Optical Distribution Network
OLT	Optical Line Termination
ONU	Optical Network Unit
PDP	Power Distribution Panel
POTS	Plain Old Telephone Service

ppm	parts per million
QoS	Quality of Service
SCB	Single Copy Broadcast
SDH	Synchronous Digital Hierarchy
SFP	Small Form-factor Pluggable transceiver
SIP	Session Initiation Protocol
SNI	Service Node Interface
SNMP	Simple Network Management Protocol
SP	Strict Priority
STB	Set Top Box
STM	Synchronous Transport Module
TCP	Transmission Control Protocol
TDM	Time Division Multiplex
TG	Trunk Gate Way
ToS	Type of Service
UDP	User Datagram Protocol
UNI	User-Network Interface
VDN	Video Distribution Network
VLAN	Virtual Local Area Network
VoIP	Voice over Internet Protocol
WRR	Weighted Round Robin

Product Documentation Customer Satisfaction Survery

Thank you for reading and using the product documentation provided by FiberHome. Please take a moment to complete this survey. Your answers will help us to improve the documentation and better suit your needs. Your responses will be confidential and given serious consideration. The personal information requested is used for no other purposes than to respond to your feedback.

Name	
Phone Number	
Email Address	
Company	

To help us better understand your needs, please focus your answers on a single documentation or a complete documentation set.

Documentation Name	
Code and Version	

Usage of the product documentation:

1. How often do you use the documentation?

☐ Frequently ☐ Rarely ☐ Never ☐ Other (please specify) _____

2. When do you use the documentation?

☐ in starting up a project ☐ in installing the product ☐ in daily maintenance ☐ in trouble shooting ☐ Other (please specify) _____

3. What is the percentage of the operations on the product for which you can get instruction from the documentation?

☐ 100% ☐ 80% ☐ 50% ☐ 0% ☐ Other (please specify) _____

4. Are you satisfied with the promptness with which we update the documentation?

☐ Satisfied ☐ Unsatisfied (your advice) _____

5. Which documentation form do you prefer?

☐ Print edition ☐ Electronic edition ☐ Other (please specify) _____

Quality of the product documentation:

1. Is the information organized and presented clearly?

☐ Very ☐ Somewhat ☐ Not at all (your advice) _____

2. How do you like the language style of the documentation?

☐ Good ☐ Normal ☐ Poor (please specify) _____

3. Are any contents in the documentation inconsistent with the product?

_____

4. Is the information complete in the documentation?

☐ Yes

☐ No (Please specify) _____

5. Are the product working principles and the relevant technologies covered in the documentation sufficient for you to get known and use the product?

☐ Yes

☐ No (Please specify) _____

6. Can you successfully implement a task following the operation steps given in the documentation?

☐ Yes (Please give an example) _____

☐ No (Please specify the reason) _____

7. Which parts of the documentation are you satisfied with?

_____

8. Which parts of the documentation are you unsatisfied with?Why?

_____

9. What is your opinion on the Figures in the documentation?

☐ Beautiful ☐ Unbeautiful (your advice) _____

☐ Practical ☐ Unpractical (your advice) _____

10. What is your opinion on the layout of the documentation?

☐ Beautiful ☐ Unbeautiful (your advice) _____

11. Thinking of the documentations you have ever read offered by other companies, how would you compare our documentation to them?

Product documentations from other companies:_____

Satisfied (please specify) _____

Unsatisfied (please specify) _____

12. Additional comments about our documentation or suggestions on how we can improve:

_____

_____

Thank you for your assistance. Please fax or send the completed survey to us at the contact information included in the documentation. If you have any questions or concerns about this survey please email at edit@fiberhome.com.cn