SPECIAL TOPIC

Home Gateway Based on Telecom Networks

Abstract:
With the emerging triple play and even multi play, it is becoming increasingly important to deploy home gateway in the home networks. Therefore, it is necessary to have comprehensive knowledge of the home gateway based on telecom networks and to position it accurately. The home gateway is the equipment for the communication between inner and outer areas of the home networks, offering technical measures as Quality of Service (QoS), security, and management. Through the home gateway, the home network can provide services as home communications, information, entertainment, home offices, intelligent home services, and more. The technology of home gateway is immature and different manufacturers on the industry chain need to work together to promote its progress.

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Facing the fast development of home and individual communication, people post stronger demands for diversified communications, for instance, data and multimedia applications and home networks. With the extensive invading of IT to the electric home appliance industry, the exchange and compatibility of data between the two industries become the hot spot for study.

The current Small Office Home Office (SOHO)/Home router, cable modem, and DSL modem have provided diversified communication access methods, and completed the task of "last mile" access. This is clearly indicated by the aspect of telecom network with the further popularity of home wideband access. However, the enhancement in network access function hasn't brought brand new live experience to the consumers. Only providing data access methods and access terminals without innovations have become a constriction of the further development of wideband and home networks.

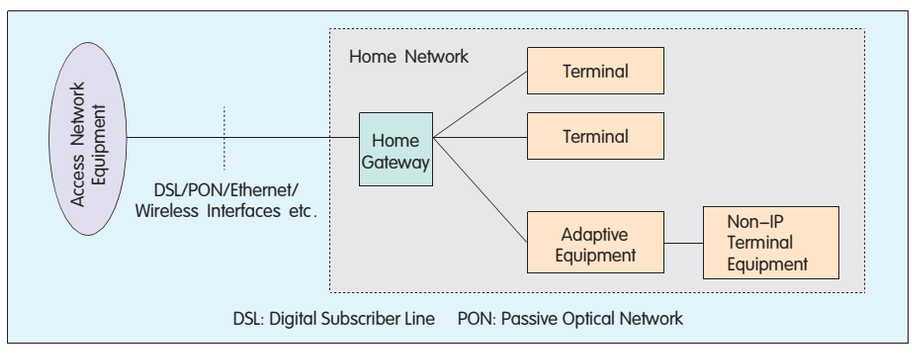
A common understanding is forming in the telecom industry that intelligent, standardized, and flexible home gateways will replace current single access terminals and become the solution for setting up home networks.

1 The Definition and the Characteristic of the Home Gateway

The home gateway based on telecom networks is the interface unit connecting home networks and outer networks. It should be capable of providing functions such as home networking, Quality of Service (QoS), security management, maintenance management, address management and data forwarding. In addition, it should provide extension for specified applications and basic access functions.

The location of home gateways in home networks is shown in Figure 1. The home gateway can directly connect to outer access equipment through different interfaces (for instance, Digital Subscriber Line (DSL), Passive Optical Network (PON), Ethernet and wireless interfaces)[1].

The home gateway based on telecom networks must have two main features: capable of providing wideband access and capable of data processing based



▲Figure1. The location of the home gateway in the home network.

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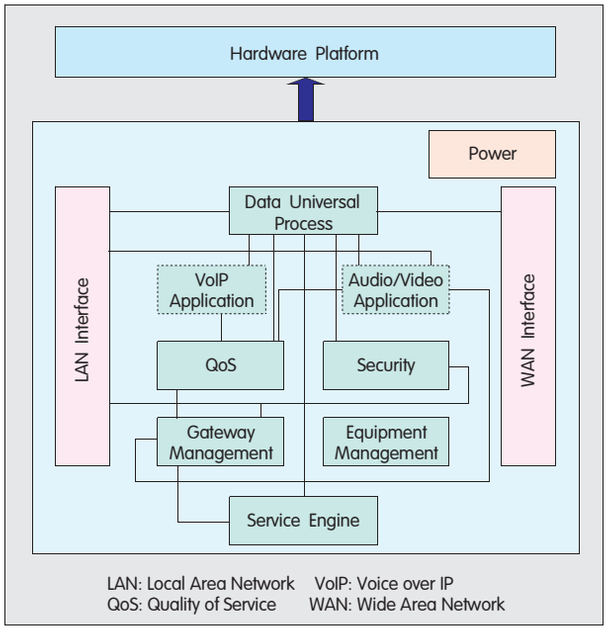


◀ Figure 2. The home gateway architecture.

on IP. As With the application business based on wideband becoming richer, home gateway must include the following key elements.

- Supporting the remote management for home gateways, home networks, and home application terminals.
- Ensuring equipment and applications in the home networks access the business platform under the protection of QoS.
- Development on equipment discovering and collaborative applications.
- Becoming the link among equipment on the home network.

2 Key Technologies of the Home Gateway

The home gateway, which should meet the following basic requirements, is the device for the equipment on home network to communicate with the outer network.

- Having Wide Area Network (WAN) side interfaces (for instance DSL, Ethernet).
- Having Local Area Network (LAN) side interfaces (for instance, Ethernet, WiFi, Bluetooth, and USB).
- System processing capacity to meet application requirements (for instance CPU, storage, and disk).
- Offering end-to-end bi-directional security guarantee.
- Supporting multiple services such as voice and video, and being capable of application extension.
- Supporting plug and play, and self-configuration.
- Satisfying QoS guarantee based on business class.
- Supporting remote management.

2.1 The Reference Model for Home Gateway Functions

The home gateway is the core of a home network. In addition of the above requirements, the flexible extension capability should also be considered. On one hand, through extension users can use the existing home facility. On the other hand, the capability of extension satisfies the home environment with the growing service requirements. Therefore, it is widely accepted to define reasonable home gateway architecture through dividing by function modules.

The home gateway architecture in Figure 2 has been embodied in mainstream gateway products[2].

Figure 2 shows, the QoS, security, and gateway management are the key modules in the home gateway.

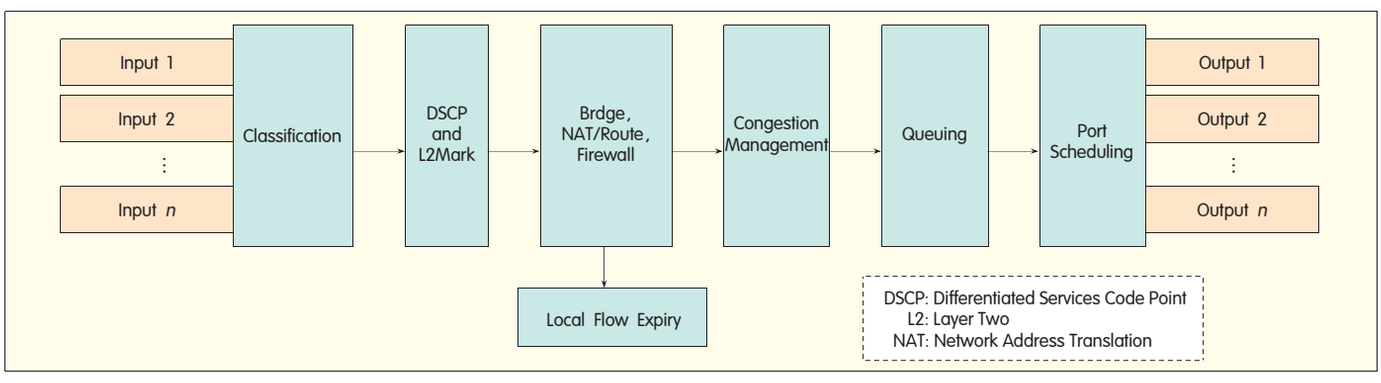
2.2 QoS of the Home Gateway

As the triple play and even multi play services are becoming apparent the requirement for QoS is a must. The QoS is meaningful only when end-to-end is realized, consequently, the home network must adopt the QoS technology. It is significant for the services, provided by operators and home network inner applications, to apply the QoS technology.

Main QoS technologies applied in the home gateway includes stream classification, mark, congestion management, priority queuing, flow shaper, output scheduling, and more. Figure 3 offers a QoS realizable model adoptable for home gateway[3].

2.3 The Security of Home Gateway

Main concerns about the security in



▲ Figure 3. The home gateway QoS realized model.

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home gateway include:

(1) Equipment Security

To isolate the home inner equipment and network from the outer network, technologies such as firewall, Network Address Translation (NAT), anti-port-scanning, and Denial of Service (DoS) can be used. In addition, log function is provided for tracing and analyzing on network security problems.

(2) User Personal Information Management

The usual method for user identity verification is using user name and password. To guarantee the reliability such authentication and authorization must adopt a safe method. Digital certificate and signature method can be used to verify the uniqueness of user, and meantime important information of the identity is encrypted during transmission. Hypertext Transfer Protocol (HTTP) and Internet Protocol Security Virtual Private Network (IPSec VPN) are the usual adopted methods.

(3) The Information Control Filter

The information control filter includes website filtering and parent control (different terminals have different limitations in accessing the home gateway).

2.4 The Home Gateway Management

The management of home gateway in the environment of home networks involves the following contents:

(1) Management on the Gateway

Management on the gateway includes remote management, parameter configuration management, and service configuration management of gateway software.

(2) Management on the Gateway Connection Equipment

Management on the gateway connection equipment includes remote management of the gateway connecting equipment, connecting equipment discovery, and address allocation management.

(3) Plug and Play under Zero-touch Service

From the aspect of users, the less participation of users is the better for the management of home gateway equipment. Adoptable method includes pre-configuration of the distributed equipment, or providing installation disc for users to quickly install the equipment (similar to installation software).

Currently adoptable remote management protocol includes TR069 and Simple Network Management Protocol (SNMP). The management system based on TR069 will gradually become the main stream.

3 Services Provided through the Home Gateway

Services of the home network are decided by the final requirements of users, and meantime are decided by the capacity of home equipment. The current study progress is indicating that services provided by the home network and set up through the home gateway can be classified as the following:

(1) Home Communication after Broadband Access

The home communication as the basic service includes different telephone services, for instance, voice phone such as fixed telephone, IP phone, mobile phone, and Personal Handy-phone System (PHS). The increasing broadband capacity brings the possibility for more families that the video communication such as videophone and multi party videoconference become reality. Family as the component of a society has its communication that includes communication within family members and communication with the outside world.

(2) Home Entertainment and Information Services

The home entertainment is the extension of traditional communication field provided by telecom operators. The home entertainment is capable to provide comprehensive information through cooperation with IT manufacturers, electric home appliance manufacturers, and radio and TV content providers. Information services mainly satisfy the requirements of family members for inside and outside information, and ensure the convenience and customized services through multiple methods. The cooperation with content providers, home entertainment can provide rich information sources for family users. In addition, home entertainment satisfies the diversified requirements for information and realizes the comprehensive information providing capacity.

(3) Home Office

The trend of paperless office and networking in office, the home office becomes possible through remote access enterprise network. This access network will be setting up equipment in home office environment such as fax machines and network printers, and video conference phones to participate in enterprise office collaboration.

(4) Intelligent Home Services

The realization of intelligent home service (for instance, intelligent electrical home appliance, home security, and more) has far exceeded the telecom field. The actual realization will bring great changes to our live. The most difficulty hinders the development is not the technical factor, but the difficulty for collaboration of manufacturers from different industries to work together to speed up the development.

4 Conclusion

The rise of home network market comprehensively unfolded the study on home gateway. The lack of uniform standard and product properties vary greatly, but with the promoting efforts from the manufacturers on different positions of the industry chain, technologies of home gateway will become mature soon.

References

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Biography

Wang Min was graduated from Beijing Institute of technology. He is chief engineer of ZTE network business multi-media terminal product line and in charge of many R&D projects such as ATM, DSLAM, and home gateway terminals. His research field includes home gateway, home network, and IPTV.

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