

Service and User Integration Management Method and System in Ethernet Service Operation

Technology Field

The present invention involves to the information network technology area, especially involves to a service and user integral management method utilizing the Ethernet layer 2 expansion technology in MAN, WAN and LAN Ethernet and system thereof.

Background

As the result of reducing network cost exposed by operation support system, the Ethernet technology which was originally intended to apply to the LAN now gets a new life. The expansion of applying area and the variety of services require the packet format of Ethernet technology to be extended so as to support the new mode of service and connectivity, that is, require a hierarchical approach to address the expanding issue. Presently, IEEE has developed two approaches, IEEE 802.1ad and IEEE 802.1ah. IEEE 802.1ad provider bridge, also known as Q-in-Q or VLAN stacking, expands the original concept of VLAN. IEEE 802.1d simply adds a new Q tag to permit the service to provide its own managing tags to identify individual customer network, and the original Q-tag could be used to identify the VLANs in customer network. Although IEEE 802.1d supports a hierarchy of 3 levels, the service provider could create only 4096 customer VLANs, which is not enough in large metropolitan and regional networks. This shortcoming is overcome by using IEEE 802.1ah provider trunk bridge that encapsulates a customer MAC header by a service provider MAC header. Comparing with the additional-Q-tag separating end customer, utilizing a 24-bit service tag in the service provider MAC header theoretically supports the 16 millions service instances, which fully resolves the expanding problem. IEEE 802.1ad standard had been published in 2006, yet IEEE 802.1ah is in draft at present. With the development of technology and appearance of the new demand, the new expansion to layer 2 Ethernet frame format is possible.

In the current Operation Support System, the management of the services and users generally employed customization of the high layers above the IP layer so as to perform

the service identification, the user authentication, and the service usage billing, etc., such as defining payload format of packet using XML schema to transport in SOAP protocol; or directly transferring the above information in HTTP transport protocol, etc. (all of them are dependent on system implementation, and the vendors have their own ways of implementation based on the individual case). The common character of these methods is end-to-end solution, without utilizing the features of intermediate network, so that although the solution is easy to extend, it leads to degradation of performance and security.

The Summary

One object of the present invention is to provide a service and user integral management method utilizing Ethernet layer 2 expansion technology and system thereof. The method and system of the present invention can be used in the scenarios such as the operation management, the access authentication of user, the service usage in metropolitan area, wide area or regional area Ethernet service. The system of the present invention includes a Customer Premier Equipment (CPE), a Network Premier Equipment (NPE), a Router and an Authentication, Authorization & Accounting (AAA) server. The present invention takes advantages of the features of Ethernet layer 2 expansion technology, resolves the problem of the integral management of the services and users and has the merits such as high identifying service efficiency, and excellent traffic separation.

To realize the above-mentioned object of the present invention, the service and user integral management method utilizing Ethernet layer 2 expansion technology of the present invention specifically includes the following sub-methods: 1) the method mapping the corresponding fields of the packet format of Ethernet layer 2 expansion technology to the service and user, 2) the method requesting service, 3) the method updating the service status, and 4) the method terminating service. The present invention also involves to a layer-2 frame forwarding method and a layer-2 expanding frame parsing method. The prior Ethernet layer 2 expansion technology currently includes IEEE 802.1ad and IEEE 802.1ah, and the other possible new expansion technology.

According to the method of the present invention, wherein,

1) the said method mapping the corresponding fields of packet format of the Ethernet layer 2 expansion technology to the service and user refers to employing the fields currently not fully utilized or one or several fields already used individually in the packet

format of Ethernet expansion technology, by redefining individual bit of the single field, or combining the several fields, or making use of the remaining value space which is not fully used, to match these bits to service id and user id;

2) the method requesting service refers to the procedure that the Customer Premier Equipment (CPE) obtains the request flag and service id, and completes mapping and encapsulating the service id and user id in the said mapping method along with the network premier equipment, to form the integral expansion layer 2 data frame which is transmitted upward along the Ethernet line to the router which decapsulates the Ethernet data frame so as to transmit the layer 2 payload as per the over-layer 3 Internet Protocol, wherein the said router is required to log the header information plus timestamp of the layer 2 expanding frame, and send the log to AAA equipment which resolves the records of the log to implement the initial related AAA functions, periodically or in real time;

3) the method updating the status of the service refers to setting the flag into updating status, and performing the same steps as those of the said method requesting service;

4) the method exiting the service includes the methods of exiting the service normally and abnormally, respectively, in which, the said method of exiting the service normally refers to setting the flag into exiting status, and performing the same steps as those of the method requesting service, so that they are differed in that the flag bit for requesting service is "requesting" and that for exiting service is "exiting"; and the said method of exiting service abnormally refers to that upon checking the updating timer of service status, if the said router finds it timeout, it will set the service to exit abnormally, log the header of the original expanding frame plus the timestamp, and send, periodically or in real time, the log to AAA equipment which resolves the record of the log to implement related AAA functions.

Additionally, the managing service and user management integral system utilizing the Ethernet layer 2 expansion technology including a Customer Premier Equipment (CPE), a Network Premier Equipment (NPE), an Ethernet, a Router and an AAA equipment, of the present invention, is characterized in that, the said system maps the corresponding fields of the packet format of Ethernet expansion technology to the service and user, employs the fields currently not fully utilized or one or several fields already used individually in the packet format of Ethernet expansion technology, by redefining individual bits of single field, or combining the several fields, or making use of the remaining value space which is

not fully used, to map these bits to the service id and user id, wherein, the Ethernet layer 2 expansion technology includes IEEE 802.1ad and IEEE 802.1ah.

Additionally, during requesting the service for the system, the said Customer Premier Equipment obtains the request flag and service id, completes mapping and encapsulating the service id and user id of the said mapping method together with the Network Premier Equipment to form the integral expanded layer 2 data frame which is and transmitted along the said Ethernet line upward to the said router terminating the layer 2 frame to decapsulate the Ethernet header and encapsulate the payload of layer 2 into layer 3 protocol payload to transmit. The said router needs to log the header of layer 2 expanding frame plus the timestamp and sends, periodically or in real-time, the log to AAA Equipment which resolves the record of the log to implement the initial related AAA functions.

Additionally, during updating the service status for the system, the said Customer Premier Equipment sets the flag bit into updating, and performs the same actions as those of requesting service.

Additionally, during exiting service including normally exiting service and abnormally quitting service, the said normally exiting service refers to setting the flag bits into exiting, and performing the same actions as those of requesting service; and the said abnormally quitting service refers to that upon checking the service status updating timer, if the said router find out it expired, it will set the flag bits into abnormal quitting, log the header of the original layer 2 expanding frame and the timestamp, and send periodically or in real-time, the log to AAA Equipment which resolves the record of logging to implement the initial related AAA functions.

Compared with the conventional method, the present invention has the following advantages:

(1) by using layer 2 information the service id and user id map to the corresponding fields of Ethernet layer 2 expansion technology, so that the method of the present is characteristics of difficulty to forge.

(2) The method and system of the present invention efficiently realizes the separation and identification of the service and user by using layer 2 technology, so that they are implemented simply and contain the prior Ethernet technology.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows the graph of entities relationship of the system applying the service and user integral management method utilizing Ethernet layer 2 expansion technology of the present invention.

Figure 2 shows the 802.1ad packet format used in the of service and user integral management method utilizing Ethernet layer 2 expansion technology and system thereof.

DETAILED DESCRIPTION

Hereafter, the present invention will be illustrated in detail with reference to the figures.

Figure 1 shows the graph of entities relationship of the service system applying the service and user integral management method utilizing Ethernet layer 2 expansion technology of the present invention. As shown in the figure 1, the service system of the present method includes the entities such as the Customer Premier Equipment (CPE), the Network Premier Equipment (NPE), the router and AAA Server.

The service and user integral management method utilizing Ethernet layer 2 expansion technology of the present invention specifically includes the following sub-methods: 1) the method mapping the corresponding fields of packet format of Ethernet layer 2 expanding technology to the service and user, 2) the method requesting service, 3) the method updating service status, and 4) the method terminating service. It also involves to layer 2 frame forwarding method and layer 2 expanding frame parsing method. The prior Ethernet layer 2 expansion technology currently includes IEEE 802.1ad and IEEE 802.1ah, and the other possible new expansion technology.

The method according to the present invention, wherein,

1) the method mapping the corresponding fields of packet format of Ethernet layer 2 expansion technology to the service and user refers to employ the fields currently not fully utilized or one or some fields already used individually in the packet format of Ethernet expansion technology, by redefining the individual bits of the single field, or combining the several fields, or making use of the remaining value space which is not fully used, to map these bits to the service id and user id.

2) the method requesting service refers to the procedure that the CPE obtains the request flag and service id, and completes mapping and encapsulating the service id and

user id in the said mapping method together with the network premier equipment to form the integral expanded layer 2 data frame which is transmitted along the Ethernet line upward to the router which obtains the payload by decapsulating the Ethernet frame so as to transmit the layer 2 payload as per over-layer-3 Internet Protocol. The said router is required to log the header information plus timestamp of the layer 2 expanded frame, and send, periodically or in real time, the log to AAA equipment which resolves the records of the log to implement the initial related AAA functions.

3) The method updating the status of service refers to set the flag into updating status, and perform the same steps as those of the said method requesting the service, so that they are differed in that the flag bit in the said method requesting the service is set into 'requesting', and that in the method updating the service status is set into 'updating'.

4) The method exiting service includes the methods of exiting service normally and abnormally, in which, the said method of exiting service normally refers to setting the flag bits into exiting status, and performing the same steps as those of the said method requesting the service, so that they are differed in that the flag bit in the method requesting the service is set into 'requesting', and that in the said method exiting service is set into 'exiting'; and the said method exiting service abnormally refers to that upon periodically checking the updating timer of service status, if the router found it timeout, it will set the service as exiting abnormally, log the header of the original layer 2 expanding frame of Ethernet plus the timestamp, and send, periodically or in real time, the said logs to AAA equipment which resolves the record of the logs and implements the initial related AAA functions.

Hereafter, the service and user integral management method utilizing Ethernet layer 2 expansion technology and system thereof of the present invention will be described in detail by combining with the figures and specific implementation examples.

EXAMPLES

The service and user integral management method utilizing Ethernet layer 2 expansion technology and system thereof of the present invention will be illustrated by combining with IEEE 802.1ad layer 2 expanding.

Figure 2 shows the packet format of IEEE 802.1ad used in the service and user integral management method utilizing Ethernet layer 2 expansion technology of the

present invention. IEEE 802.1ad, Q-in-Q primarily, developed for expanding the quantity of VLAN, was implemented by adding an 802.1Q tag fields to the original 802.1Q packet format, resulting in increasing the number of VLAN up to 4k*4k. With the development of metropolitan area Ethernet and the requirements of the refined operation of carriers, the double tags of Q-in-Q can be further applied. As shown in the table 1, its internal and external tags may represent the different information, such as, the internal tag representing user, and the external tag representing service. Additionally, the frame of Q-in-Q carrying with the double tags transverses the carrier network, wherein the internal tag is transparently transported, which is a simple and practical VPN technique, so that it may be the extension of core MPLS VPN to the metropolitan area Ethernet, and finally form the end-to-end VPN technique. In this implementation example, the Q-in-Q is applied to the management of users and services, in which the internal tag represents services, and the external tag represents users.

Table 1 double VLAN maps the service id and the user id

External VLAN	Internal VLAN
User ID	Service operation and service ID

The method of the present invention can be embodied as follows:

1, Mapping the corresponding fields of Ethernet layer 2 expansion technology packet format to the services and users

In this implementing example, the 12-bit of the internal VLAN ID is redefined as follow that the most significant 2 bits represents service operation, wherein 01 denotes service request, 10 denotes service status updating, 11 denotes service normally exit, and 00 denotes service abnormally exit, and the remaining 10 bits represents service id, with the mapping relationship as shown in the table 2. The external VLAN ID is used as user ID. In the present example, service operation may be defined by extending the value of ETHERTYPE field, but the extended value of ETHERTYPE shouldn't conflict with the prior standards. Under such field redefinition and usage, description is continued as follow:

Table 2 The mapping relationship of VLAN ID to service operation and service ID

Bits 11-10	Bits 9-0
Service operation	Service ID

2, Requesting service

(1) Before enjoying service, the user obtains the service ID from the service portal, wherein the plan of service IDs and the constraints can be stipulated according to the operator's business policies, which is not covered by this description, assuming that such plan of service IDs and stipulation is available;

(2) The user issues the service request carrying with the service id in IP payload;

(3) The Customer Premier Equipment (CPE) extracts the service id;

(4) The CPE encapsulates layer 2 frame with the logical OR of service id and 0x100 as internal VLAN ID and the other parameters as layer 2 payload, and transmits the frame;

(5) The Network Premier Equipment (NPE) inserts the external VLAN according to the interface on which CPE attached and transmits it upward to the router;

(6) The router terminates the double VLANs and logs it concerning to the external VLAN ID, the internal VLAN ID, and the request parameters, etc., and sends the log to AAA (Authentication, Auditing, Authority) equipment;

(7) The AAA equipment resolves the information of double VLANs to extract the user id, the service id, the parameters and the start time.

3, Service status updating and service abnormally exiting

(1) The CPE encapsulates layer 2 frame with the logical OR of service id and 0x200 as internal VLAN ID, and transmits the frame;

(2) The Network Premier Equipment (NPE) inserts the external VLAN according to the interface on which CPE is attached and transmits it upward to the router;

(3) The router terminates the double VLANs and makes an initial analysis on the double VLANs, and if find the service operation in service status is updating, it resets the timer of service-user;

(4) If not receiving the service status updating packet for long period, that is, the service-user timer expires, the router will determine to exit service abnormally, log the termination of the double VLANs and send the log to AAA equipment.

4. Exit service

(1) The user may issue the service request carrying with service id in IP payload in case of no longer using the service;

(2) The Customer Premier Equipment (CPE) extracts service id, encapsulates layer 2

frame with the logical OR of service id and 0x300 as internal VLAN ID, and transmits the frame;

(3) The Network Premier Equipment (NPE) inserts the external VLAN according to the interface on which CPE is attached and transmits it upward to the router;

(4) The router terminates the double VLANs, logs it concerning to the external VLAN ID, the internal VLAN ID, and the parameters, etc., and sends the log to AAA (Authentication, Auditing, Authority) equipment;

(5) The AAA equipment resolves the information of the double VLANs to extract the user id, the service id, the parameters and the end time.

5. Data forwarding

The router encapsulates the double VLANs frame according to the service data stream received from Service Provider or other data source, and transmits the frame over the layer 2 Ethernet link, which is the part of standards supported by all Q-in-Q enabled equipments.

6. Service Billing

AAA equipment collects and analyzes raw data according to the log information recorded in the said steps 2, 3 and 4, and performs the services and users integral management as per the related policies.

Additionally, although this implementing example illustrates the invention with IEEE 802.1ad Ethernet layer 2 expansion technology, the other Ethernet layer 2 expansion technologies such as IEEE 802.1ah can be applied to the present invention.

WHAT IS CLAIMED IS:

1. A service and user integration management method utilizing Ethernet layer 2 expansion technology, is characterized of comprising 1) the method mapping the corresponding fields in the packet format of the Ethernet layer 2 expansion technology to the service and user, 2) the method requesting the service, 3) the method updating the status of the service, and 4) the method exiting service, wherein

1) the said method mapping the corresponding fields of the packet format of the Ethernet layer 2 expansion technology to the service and user refers to employing the fields currently not fully utilized or one or several fields already used individually in the packet format of Ethernet layer 2 expansion technology, by redefining the individual bits of the single field, or combining the several fields, or making use of the remaining value space which is not fully used, to map them to the service id and user id,

2) the said method requesting service refers to the procedure that the terminal obtains the request flag and service id, and completes encapsulating the service id and user id in the said mapping method together with a network premier equipment, so as to form the integral expanded layer 2 data frame, which is transmitted upward along the Ethernet line to a router terminating the said layer 2 data frames to decapsulate the Ethernet frame and transporting the layer 2 payload as per over-layer-3 Internet Protocol, wherein the said router is required to log the header information and timestamp of the layer 2 expanded frame, and sends, periodically or in real time, the log to AAA equipment which resolves the records of the log to implement the initial related AAA functions,

3) the said method updating status of service refers to setting the flag into the updating status, and then performing the same steps as those of the said method requesting service, and

4) the said method exiting service includes methods of exiting the service normally and abnormally, wherein, the said method exiting service normally refers to setting the said flag into the exiting status, and then performing the same steps as those of the said method requesting service; and the said method exiting the service abnormally refers to that upon checking the updating timer of service status, if finding it timeout, the router sets the service into an abnormal exiting, log the header information of the original expanding frame of Ethernet and the timestamp, and send, periodically or in real time, the logs to

AAA equipment resolving the record of log to implement related AAA functions.

2. The method according to the claim 1, is characterized in that the status updating operation of the said method updating the status of the service may be sent in programmable period by the terminal.

3. The method according to the claims 1 or 2 is characterized in that the said Ethernet layer 2 expansion technology includes IEEE 802.1ad and IEEE 802.1ah.

4. The method according to the claim 3 is characterized in that, as for the said method mapping the corresponding fields in packet format of the Ethernet layer 2 expansion technology IEEE 802.1ad to the service and user, 12 bits of internal VLAN ID is redefined as the first 2 bits representing service operation and the following 10 bits representing served ID, and the external VLAN ID is taken as user ID.

5. The method according to the claim 3 is characterized in that as for the said method requesting service utilizing the Ethernet layer 2 expansion technology IEEE 802.1ad, the said terminal equipment fetches the service id, and encapsulates the layer 2 frame with the **service id | 0x100**, as internal VLAN id and the content of the other parameters of service request as layer 2 payload and transmits it, and the said Network Premier Equipment encapsulates the external VLAN according to port linked by said terminal equipment and transmits the frame upward to the said router.

6. The method according to the claim 3 is characterized in that as for the said method updating the status of the service and the said method exiting service abnormally utilizing the said Ethernet layer 2 expansion technology IEEE 802.1ad, the said terminal encapsulates the layer 2 frame with the **service id | 0x200**, as internal VLAN id and transmits it, the said Network Premier Equipment encapsulates the external VLAN according to port linked by the said terminal equipment and transmits the frame upward to the said router, and the said router terminates such double VLANs and makes an initial analysis on it, wherein if the operation is into updating status of service, the router will reset the service-user timer; and if not receiving the status of service updating packet for a

long time, the said router will log the said VLAN to be abnormally exited and send the said log to AAA equipment.

7. The method according to the claim 3 is characterized in that as for the said method normally exiting service utilizing the said Ethernet layer 2 expansion technology IEEE 802.1ad, upon terminating the service, the request of exiting service with the service id is sent, while the said terminal equipment encapsulates the layer 2 frame with **service id | 0x300**, as internal VLAN id and transmits it, the said Network Premier Equipment encapsulates the external VLAN according to port linked by the said terminal equipment and transmits the said frame upward to the said router, and the said AAA equipment makes an analysis on such double VLANs information to obtain the user id, service id, parameters and terminating time.

8. A service and user integration management system utilizing the Ethernet layer 2 expansion technology which includes a Customer Premier Equipment, a Network Premier Equipment, an Ethernet, a Router and an AAA equipment, is characterized in that,

the said system maps the corresponding fields of the packet format of the Ethernet expansion technology to the service and user, employs several fields currently not fully utilized or one or several fields already used individually in the packet format of the Ethernet expansion technology, by redefining the individual bits of the single field, or combining the several fields, or making use of the remaining value space which is not fully used, to map these bits to the service id and user id;

during requesting service of this system, the said Customer Premier Equipment obtains the request flag and service id, and completes mapping and encapsulating the service id and user id along with the said Network Premier Equipment to form the integral expanded layer 2 data frame and transmit along the said Ethernet line upward to the said router which terminates the said layer 2 frame to decapsulate the Ethernet and encapsulate the payload of the layer 2 into the over-layer 3 protocol payload so as to transmit, Wherein the said router logs the header of the layer 2 expanding frame and the timestamp and sends the said log periodically or in real-time to the AAA Equipment which resolves the record of the log to complete the initial related AAA functions;

during updating service status of the said system, the said Customer Premier Equipment sets the flag bits into updating, and performs the same actions as that of the

said requesting service; and

during existing service of the said system, including normally exiting service and abnormally quitting service, the said normally exiting service refers to setting the flag bit into exiting, and performing the same actions as those of the said requesting service; and the said abnormally quitting service refers to that upon checking the service status updating timer, if the said router finds out it expired, it will set the flag bits into abnormal quitting, log the header of the original layer 2 expansion frame and the timestamp and send the said log periodically or in real-time to AAA Equipment which resolves the record of the log to implement the initial related AAA functions.

9. The system according to the claim 8 is characterized in that the said updating service status may be invoked in a configurable periodic way by the Customer Premier Equipment.

10. The system according to the claims 8 or 9 is characterized in that the said Ethernet layer 2 expansion technology includes IEEE 802.1ad and IEEE 802.1ah.