Service Provision for Future Access Networks Using PPP Extensions

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Abstract: The services such as real-time audio and video applications have become increasingly popular, especially over the Internet. Furthermore, as being commercialized those contents on the Internet require quality of service (QoS) support to ensure their performance.

PPP is the best solution to offer those kinds of services. The reason why we want to employ PPP is this satisfies most of the requirements associated with remote connectivity to an NSP, such as IP address assignment, security, and AAA (authentication, authorization and accounting). In addition, since ISPs and corporations are familiar with PPP based connectivity, easy migration from existing ISP infrastructure is expected, if QoS is guaranteed. But so far PPP has had no field to ensure the quality of service.

This article presents the solution by using some tunneling protocols and the draft [1] that proposed additional LCP option fields to negotiate QoS. To communicate each other, after negotiating those option fields, over various protocols such as ATM, Ethernet, and etc. tunneling protocol is used. Following sections will mention those briefly. And the service provision to offer the end-to-end communication with negotiated QoS will also be proposed.

1. Introduction

Nowadays Internet access architectures for residents, SOHO (Small Office Home Office) and local area network subscribers are being developed largely. The sorts of services that they want here are broadcast, point-to-point, and point to multi-point connectivity. This paper concentrates on the provisioning of services using point-to-point protocol (PPP) in access network. PPP is a well-known service in circuit-switched telephone networks. But it is also considered a good choice for the delivery of broadband services. For the reason of PPP's usefulness in access network, I have shown most recently mentioned subjects are related PPP such as PPPoE (PPP over Ethernet), PPP over ATM, PPP for QoS. And finally using those techniques I propose a total solution for end-to-end or end-to-provider communication with supporting QoS in broadband IP access network..

2. PPP Extensions

2.1 L2TP over Access Network

L2TP is a tunneling protocol that allows tunneling of PPP sessions between a so-called L2TP Access Concentrator (LAC) and an L2TP Network Server (LNS). The main focus of L2TP is on supporting HDLC based ISDN/PSTN access networks. But this section augments the procedures described in L2TP to further support ATM SVC or PVC based access networks. The extensions, defined by the draft [2][3], allow for asymmetric bi-directional call establishment and service selection in the ATM access network.

Support for ATM access networks requires extensions to the present L2TP procedures along the following lines [3]:

- the traffic management aspects of ATM connections
- the addressing format to be used in switched ATM networks and
- the limitations imposed on LCP negotiation by transporting PPP over AAL5 over the access network segment of the PPP connection.

The necessary extensions to L2TP are defined to cope with above issues which is not specific to ATM may be solved as described in L2TP link.

The procedures as defined in L2TP apply mainly to access network technology such as PSTN and ISDN, which may be respectively asynchronous HDLC and synchronous HDLC based. The aim of us is to extend L2TP support to allow communications based on ATM access network technology.

Due to the wide variety of existing signaling protocols and ATM service categories, and their support or non-support within ATM based access networks, this article takes as approach to provide for a flexible identification of ATM connection characteristics while establishing outgoing and incoming L2TP calls. The procedures as defined within documents [3] allow the allocation of asymmetric bandwidth and service category selection in terms of real or non-real time requirements on the ATM portion of the access network.

As such, the detailed signaling protocol specific information elements that are necessary for switched VC service are not negotiated during call establishment over the L2TP tunnel.

In order to identify the endpoint of the ATM connection within the ATM access network, SVCs can be

established on the basis of the ATM end system-addressing format [AESA]. For PVC based services, the PVC can either be referred to by using the ATM end system addressing procedure (Number), or by making use of a textual name (Name).

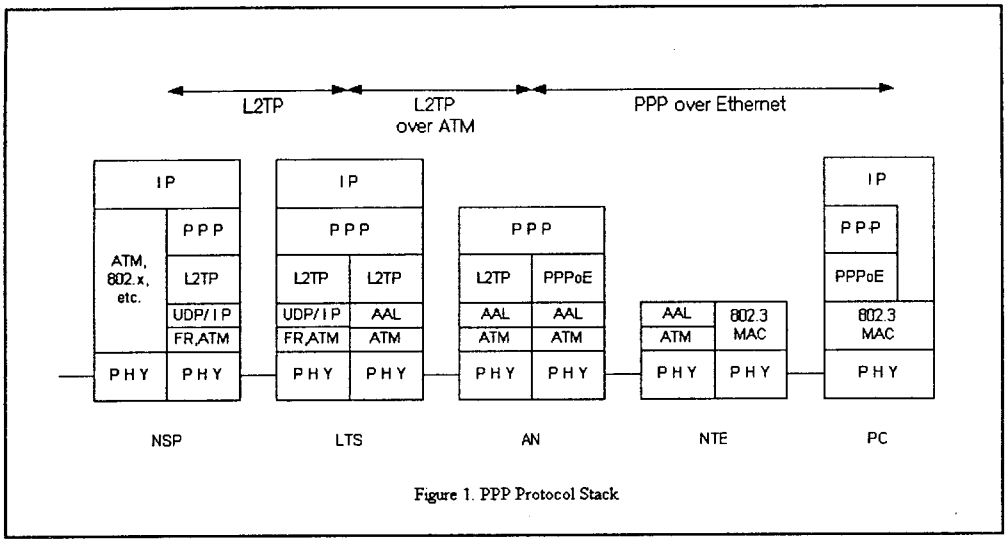

Figure 1. PPP Protocol Stack

2.2 PPP over Ethernet

Recent access technologies are faced with a few conflicting goals. It is desirable to connect multiple hosts at a remote site through the same customer premise access device. And it is also a goal to provide access control and billing functionality in a manner similar to dial-up services using PPP. In many access technologies, the most cost effective method to attach multiple hosts to the customer premise access device is via Ethernet. In addition, it is desirable to keep the cost of this device as low as possible while requiring little or no configuration.

PPP over Ethernet (PPPoE) provides the ability to connect a network of hosts over a simple bridging access device to a remote Access Concentrator [4]. With this model, each host utilizes it's own PPP stack and the user is presented with a familiar user interface. Access control, billing and type of service can be done on a per-user, rather than a per-site, basis.

To provide a point-to-point connection over Ethernet, each PPP session must learn the Ethernet address of the remote peer, as well as establish a unique session identifier. PPPoE includes a discovery protocol that provides this.

PPPoE has two distinct stages. There is a Discovery stage and a PPP Session stage. When a Host wishes to initiate a PPPoE session, it must first perform Discovery to identify the Ethernet MAC address of the peer and establish a PPPoE SESSION_ID. While PPP defines a peer-to-peer relationship, Discovery is inherently a client-server relationship. In the Discovery process, a Host (the client) discovers an Access Concentrator (the server). Based on the network topology, there may be more than one Access Concentrator that the Host can communicate with. The Discovery stage allows the Host to discover all Access Concentrators and then select one. When Discovery completes successfully, both the Host and the selected Access Concentrator have the information they will use to build their point-to-point connection over Ethernet.

The Discovery stage remains stateless until a PPP session is established. Once a PPP session is established, both the Host and the Access Concentrator must allocate the resources for a PPP virtual interface.

2.3 PPP Extensions for QoS

If PPP tunnel is setup over ATM and Ethernet, the preparation for QoS mapping extensions to PPP is completed. The QoS extensions facilitate the mapping of particular flows to a given physical link and with a given PPP class. The extensions are intended to provide more flexible quality of service support for networking environments. In the service mapping draft [1], only guidelines on how to map packets into multiple PPP [5] Quality of Service classes are given. Again, the PPP peer cannot know the class numbers or types until it receives the bearer traffic. That draft also does not mention how to map different PPP QoS classes into different wireless links. The draft [1] presents 2 LCP options [Figure 2] that are defined to allow communicating interfaces:

- send packets of a particular class number to a particular link in a link bundle
- provide upfront information on the specific classes to be supported rather than wait until packets of that class appear.

These extensions are intended for those implementations that desire to use the multilink PPP capability but also need to allocate specific flows to a given physical link.

The requirements to support QoS are

- providing a mechanism such that real-time multimedia flows that can be carried over multiple PPP
- achieving quality of service requirements for each of the PPP links
- maintaining consistency with existing PPP LCP functionality.

During the LCP negotiation phase, the PPP peers can include the newly defined Non-sharing QoS Option [Figure 2] together with MRRU and End Point Discriminator Options. The Non-sharing QoS Option allows one to specify the number of classes to be carried on a particular link. Note that the bearer data (PPP frames) can use either the short or long sequence number fragment format with classes. The recommendation is using a different sequence number space for each physical link that supports the Non-Sharing Option.

To support the mapping of differentiated services PHBs and other Layer 3 fields to PPP QoS classes, another LCP option is defined: QoS-Map multilink header format option [Figure 2].

Say both PPP peers carry IP packets with multiple DS-code points (DSCP) [6] marked, namely DSCP Code 1, DSCP Code 2, DSCP Code 3 and DSCP Code 4. Assume that there is the desire to map DSCP Code 1 and DSCP Code 2 to PPP QoS Class 1 and DSCP Code 3 and DSCP Code 4 to PPP QoS Class 2. The PPP peers use the QoS-EMHF Option to inform one another of this mapping so that they can mark the PPP frames appropriately. Without this option, both PPP peers may perform different mapping. Equipment from different vendors may not perform the same mapping and hence it is harder to provide QoS guarantees over a PPP/MP link.

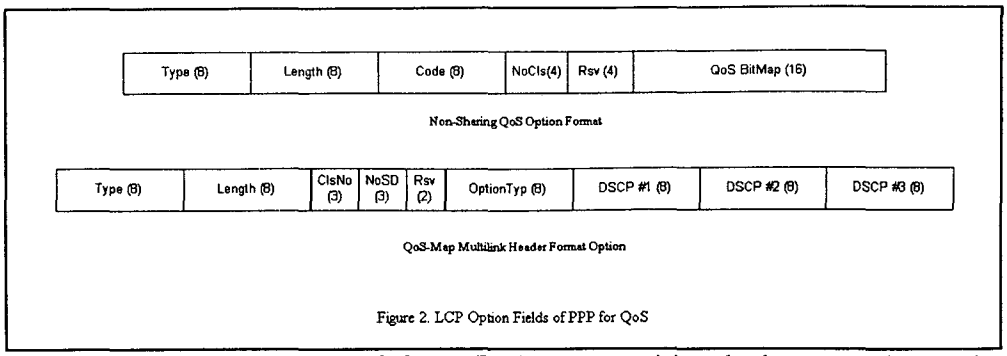

Figure 2. LCP Option Fields of PPP for QoS

The requirements for supporting QoS mechanism are followed [1]:

- Admission control can be made during the PPP negotiation phase.
- Packets with a particular class numbers to be carried over a specified physical link.
- Robust against errors
- Interoperate with existing PPP functionalities.

3. Service Provision

The [Figure 1] shows the protocol structure of our service provision. Actually to support a guarantee of a good QoS level, ATM is preferred in the access network. But to do that there is a problem. Because a ATM NIC (Network Interface Card) is too expensive fo

The use of this architecture provides the methods for an access network provider to provide open access mechanisms based on the use of the structured user name (by CHAP/PAP mechanism) for service provider selection, and secondly to provide a transport architecture solution based on virtual private IP network technology.

Those technologies satisfy following requirements: The choice of customer premises networking solutions support, NTE protocols and the transport architecture need to be carefully made in order to minimize the operational costs. Secondly to optimize transport resources and capital costs.

[Figure 1], at first PC side a user try to negotiate a certain quality of service by loading the LCP option fields on the PPP frame. If the negotiation is failed the connection is blocked. The PPPoE layer is introduced for the reason of multiplexing a number of users onto single PVC. Here the PPP packet is encapsulated in an Ethernet frame and transmitted to the NTE. Through NTE the PPP frame that the user sent is transmitted to access node. Each PPP session needs to be mapped to a PVC. The number of PVCs to be provisioned needs to be determined based on the number of simultaneous subscriber sessions expected. If fewer PVCs are provisioned, there may be service access blocking at the access node.

And the frame that has arrived at access node is forwarded to an L2TP Tunnel Switch (LTS). The LTS is able to be used optionally in the transport network to perform the grooming of traffic between tunnels. The use of an LTS makes it possible to share a tunnel by subscribers destined for different NSPs from an access node to an LTS, because at the LTS PPP sessions are groomed into appropriate outbound tunnels based on the same structured user name information.

The [Figure 3] shows the four aspects of L2TP solutions. Firstly that PPP traffic ingress is through an LAC (L2TP Access Concentrator) functional that can be provided in an access node, such as an APON OLT (Optical Line Termination) device. This LAC function allows the concentration of local traffic into appropriate tunnels, which can terminate at tunnel servers (LTS) or terminate directly at the LNS located at the NSP. Access equipment may not provide LAC functionality so PPP over ATM sessions are transported over an ATM network to a LAC located further r common users and too difficult to use. Since ISPs and corporations already have an infrastructure to support dial-up access based on PPP, a new access topology should support PPP between end user and NSPs. And end users want solutions that let themselves use their existing hardware and soft ware, or buy a standard and cheap configuration. In most of the cases, that means the configuration with an Ethernet NIC. To make all satisfy, the scenario is that we add some fields to offer QoS in a PPP frame and let customers use PPP over Ethernet. PPP is so universal that it could be applied various topologies [Figure 3]. And a provider side had better use ATM to ensure high-speed service with wide bandwidth.

At a provider side PPP connection over an ATM VC should also be setup. However, in order to extend a PPP connection from one PVC to another, and in order to allow multiple PPP connections to be multiplexed over the PVC between the service gateway and the NSP, a new protocol called L2TP should be employed. Because the L2TP allows multiple PPP calls to be multiplexed over each tunnel. Of course the we can use ADSL [7] or APON topologies below PPP session. in the network hierarchy. And existing narrowband PSTN services can be integrated with broadband PPP transport by providing L2TP support from an access node that has a function of RAS to LTS.

Lastly the Ethernet PCs explained previous are able to merged by access node through NTE.

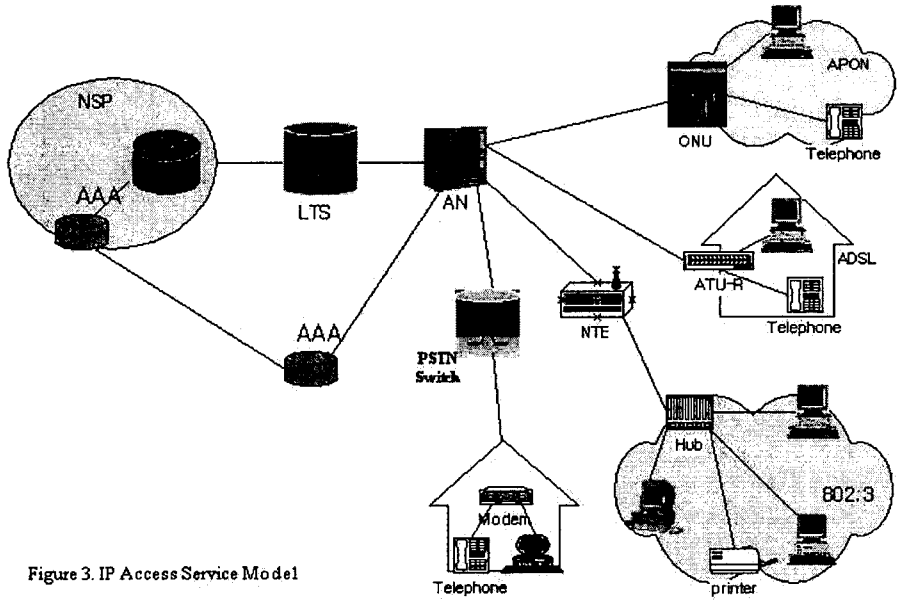

Figure 3. IP Access Service Model

4. Conclusion

The service, PPP extensions for QoS over access network is a hot topic for the provision of future communications. Although many proposals have been submitted so far, there were no articles about QoS. And that problem still remains unsolved. This paper has focused on the framework of service provisioning for the various topologies in an access network. It has presented a solution for QoS guaranteed point-to-point connections over broadband access network for future multimedia contents.

If we use this provision model with PPPoE and L2TP tunneling protocol, the most efficient mechanism for providing broadband IP access services as it supports QoS.

The remaining problem is offering security. Many of the security issues raised by the introduction of quality of service, and primarily the potential for denial-of-service attacks, and the related potential for theft of service by un authorized traffic are also applicable to these options.

Reference

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