A SERVICE MANAGEMENT PARADIGM WITH COMMON CHARACTERISTICS OF THE NETWORK BACKBONE

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Abstract Enterprises and private companies often use virtual private networks to communicate with remote sites. Traditionally, asynchronous mode core networks have been used before. (Level 2 Frame Relay), ie time division multiplexed private lines. Today, there is an increased demand for service providers to consolidate and reduce costs in the context of a highly dynamic telecommunications market. The need requires increasing revenues from their own IP network infrastructure through new capabilities: such as IP Virtual Private Networks, Virtual Private LAN services, to achieve operational efficiency through the convergence of multi-protocol switching according to all their characteristics. The new urban networking technology Ethernet can be used in combination with asynchronous transmission mode and frame relay access to provide these new services to corporate users. This should be achieved while also supporting existing technologies, such as asynchronous transmission mode, which continue to provide highly profitable services. The technical challenges discussed in the paper are met by converged features

In a multi-protocol switching network, as a traditional layer 2

services, as well as new level 3 service delivery requirements. The need for network and service interconnection is shown in terms of how they should work at the user, control and management levels to

provide smooth services in the new converged network. Various solutions defined by standards bodies are described and individual scenarios are explained.

Keywords: virtual, asynchronous, multiprotocol, switching, identifier.

1 Introduction

Multi-protocol switching (MPLS) according to the characteristics. It was originally developed to improve packet forwarding on IP core networks. However, the channel connection identifier that the multiprotocol switching feature effectively adds to IP also provides a way to add improved manageability, resiliency, traffic engineering, and quality of service (QoS) features to these networks. These features were previously referred to as advantages of asynchronous transfer mode (ATM); Therefore, feature-based multiprotocol switching currently has the potential to support services with competitive levels of availability and quality of service. Ethernet services, such as Ethernet Virtual Leased Lines (VLL) and Virtual Private Local Area Network Services (VPLS), are emerging as key new service offerings due in part to the popularity of Ethernet in the local area network environment. New IP virtual private network (VPN) services also promise new revenue opportunities for service providers. However, traditional services such as asynchronous transfer mode and frame relay remain highly profitable for service providers, and their customers are still unwilling to change the deployed corporate infrastructure.

2. Research stages, according to the general characteristics of the trunk branch of the telecommunication network.

The focus is on the intelligent use of network resources for management-level interactions and the combination of flexible service deployments. Such an approach has led to the fact that the most important requirement is the detection of faults and the provision of diagnostic capabilities, which will maximize the availability of services. This is **the situation** that new revenue streams are being sought by extending the range of services that can be provided by their IP network infrastructure without "cannibalizing" the already profitable services that can be provided by their existing asynchronous transmission mode network. These are typically Frame Relay, Asynchronous Transfer Mode, and increasingly Ethernet. Therefore, a key objective is to use IP infrastructure to extend access to existing services to new sites attached to the IP network, thereby increasing revenues from these services while providing enhanced IP services such as IP Virtual Private Networks. A further objective is to reduce capital expenditure (CAPEX) and operational expenditure (OPEX).

One of the solutions that standards bodies such as the Internet Engineering Task Force (IETF), the Asynchronous Transfer Mode Forum, the Feature-Based Multiprotocol Switching and Frame Relay Alliance (MFA) and the International Telecommunication Union - Telecommunication Standardization Sector (ITU-T) are focusing on is is the integration of existing and new services into a common IP core network using multi-protocol switching. The use of feature-based multi-protocol switching to align all services with a single IP-based core network allows service providers to take advantage of new higher-speed network backbones and a common element and network management paradigm for both Layer 3 and Layer 2 services. . This is primarily driven by the business needs of service providers to maximize profitability while minimizing risk. This is achieved by generating revenue from a wide range of both traditional and emerging services within a fixed-cost infrastructure, minimizing the need to roll out a new network for each new service, and reducing the number of skilled personnel required to operate the network. This vision also aims to reduce both the number of network nodes that must be deployed and It also functions to reduce time to market for new services. However, the new multiservice capabilities that must be added to feature-based multiprotocol switching to achieve this must be matched by operational simplicity if the promised operational cost benefits are to be realized. These benefits must outweigh the costs associated with maintaining multiple legacy networks. The above reasoning is the way to solve this task.

This paper reviews the key technical issues and describes the development of new interoperability capabilities for multiprotocol networks that are currently under consideration by industry standards bodies to enable service throughput to be maintained while new services are introduced.

3 Calculation model

In order for the new converged network to continue to support the existing services according to the characteristics in the case of multi-protocol switching, and at the same time allow the operators to launch new services, a clear vision of the requirements of this network is needed. In general, a converged network should at least meet the service capabilities of existing asynchronous transmission mode networks and also allow new services to be launched more economically than today. This should be achieved without forcing operators to build a separate network for each service. Thus, the network must be more flexible, scalable, and cost-effective than today's asynchronous transmission mode networks, while providing significant operational cost savings compared to maintaining multiple legacy networks with next-generation service networks.

The first important consequence of this is that the network must be able to handle traffic growth efficiently. Tools must be available to adapt infrastructure usage to both current and future changes in service diversity and demand. It also requires that user traffic routing policies at the network boundary take into account services, both by visibility and by selecting specific network resources. Therefore, operators can differentiate their offerings and thereby generate new revenue streams by offering services with different performance targets (eg, VLLs, Internet access) or different service classes (eg, gold, silver) from a multi-protocol network based on features. However, to meet the requirements of availability and performance targets specified in service level agreements (SLAs), this must be complemented by flexible levels of protection and recovery that provide differential offers for new services, or flexible ways in which the operator fulfills this commitment. For example, they must be able to provide local protection (channel-to-channel or node-to-node) or direct protection as required by their network design and service delivery model. Proactive and reactive operations and maintenance (OAM) procedures are key contributors to this. These provide a means of fault detection, allowing operators to take appropriate remedial action before the end user's service level agreement is breached. Fault localization and diagnosis can also be done using reactive operations and maintenance procedures. Services such as Frame Relay already benefit from the asynchronous transmission mode core network's implementation of the requirements listed above, allowing for high revenues.

Capital cost and operating cost benefits for both existing and new services must be accompanied by transparency of existing services if operators are to maintain and grow revenues. There are two elements to the evolution of a converged core network. The first is where existing services are combined according to the same characteristics in a multiprotocol switching infrastructure as the new IP services. The second is where existing services are extended with new services based on the same characteristics using a multi-protocol switching infrastructure. Continuous interaction with the new core network is required at the user, control and management levels. The development of interoperability standards at each of these levels addressed specific aspects of these requirements. At the customer level, the primary requirement is to enable transparent handover of existing customers, balancing this with network infrastructure utilization and ease of implementation. At the control level, the goal is to combine simple and flexible service deployment with intelligent use of network resources. Perhaps the most important requirement for control-level interactions is to provide the ability to detect and diagnose faults, thereby maximizing service availability. The following sections describe the various solutions currently being discussed by the Internet Engineering Working Group, the Telecommunications Standardization Sector of the International Telecommunication Union, the MFA, and the Asynchronous Transfer Mode Forum in the context of their individual scenarios.

4 Calculation results and analysis

The first step in migrating to a multiprotocol switching core network based on common characteristics is to move existing services, such as Freem relay and asynchronous transfer mode private lines, to the same characteristics on the multiprotocol switching infrastructure as the newer IP services. This is achieved by using network interactions (also known as pseudo-wired emulation in the Internet Engineering Task Force [1]), which allows networks of the same link layer to transparently communicate with an intermediate network with different link layers. Interactions are typically located within the network, providing the ability to seamlessly integrate existing and new services. Boch and Guille[2] describe network interactions in detail, including user level, control level, and quality of service, so only a brief overview is given here. In this work, these concepts are extended to show how service interactions, pragmatic control level interactions, and fault management interactions are needed to deal with a wide range of converged network scenarios.

Figure 1 shows the interoperability architecture of multiprotocol switching networks based on asynchronous transfer mode and characteristics, as specified by the Asynchronous Transfer Mode Forum and the Internet Engineering Working Group. The figure shows a single two-point diagram corresponding to a Layer 2 virtual private network segment. An asynchronous transfer mode pseudo wire (PW) (also known as a link-switched channel, LSP) crosses a multi-protocol switching network and is connected to one direction of the asynchronous transfer mode link circuit (AC) at each end. Pseudowires are multiplexed into LSPs that act as transparent tunnels,

Asynchronous transmission mode/features with multi-protocol switching interaction function located at the provider edge (PE) node. These LSPs are known as transport LSPs (T-LSPs) or packet switched network (PSN) tunnels in the Asynchronous Transfer Mode Forum and Internet Engineering Working Group, respectively. Multiplexing is achieved by embedding a 20-bit pseudo-wire feature and multi-protocol switching feature into the encapsulated user data of the asynchronous transmission mode.

The four encapsulation formats are specified by the Asynchronous Transmission Mode Forum, the Telecommunications Standardization Sector of the International Telecommunication Union, and the Asynchronous Transmission Mode Internet Engineering Working Group. N-to-1 and 1-1 modes [3] both encapsulate asynchronous transmission mode into multiprotocol switching frames according to cell characteristics , 1-1 mode requires less processing speed, and service data unit (SDU) and protocol data unit (PDU) mode is used. Asynchronous transfer mode for transferring Adaptation Level Type 5 (AAL5) service data blocks or protocol data blocks [4]. Boch and Guille provide a detailed analysis of these encapsulations and their relative merits in [2].

A pair of T-LSPs is required to provide bidirectional connectivity between any two PEs, as LSPs are unidirectional only. They are established by provisioning or characteristics by means of multi-protocol switching signaling (for ease of illustration, the figures in this paper show only one direction of a two-way pair of T-LSPs). Since ACs and pseudowires are of the same type (ie, asynchronous transmission mode), the resulting Layer 2 virtual private network scheme is called homogeneous.

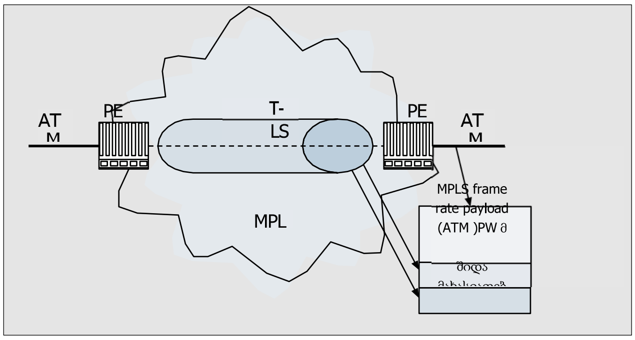

Figure 1. *Network interaction architecture*

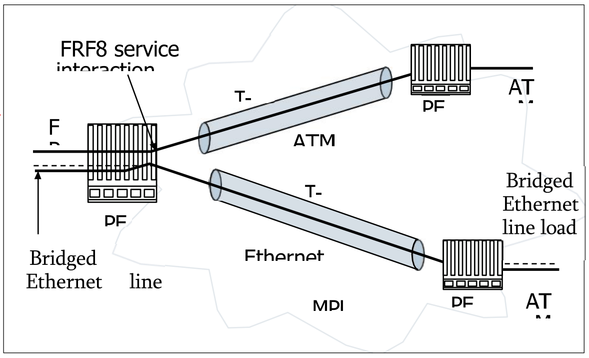

Figure 2. *Service interaction methods.*

An important factor is the ability to continue to guarantee the quality of service commitments that are made for direct services, regardless of the migration of features to the multiprotocol switching core network. Asynchronous transfer mode provides a number of well-understood and standardized tools to support quality of service, including standard categories of service and compliance definitions, standard traffic parameters, connection admission control, traffic policy and shaping, and private network-to-network interface (PNNI) quality-of-service-based routing. Frame relay also provides similar capabilities, while new developments in Ethernet, such as the use of P-bits in the Ethernet header to allow the network to process a frame with quality of service, promise to enable quality-of-service-based Ethernet services. Feature-wise, multiprotocol switching has a flexible set of techniques to support quality of service, such as support for differentiated services (DiffServ) prioritization, traffic classification, traffic engineering, and resource reservation for LSPs, allowing a wide range of quality of service strategies to be deployed. However, they must be coupled with quality of service and traffic management mechanisms in connection schemes. The Asynchronous Transfer Mode Forum proposed a set of mappings for asynchronous transfer mode parameters used in feature-based multiprotocol switching networks in [5]. However, careful engineering of T-LSP and resource management according to PE and characteristics in the multiprotocol switching core network is still required [2].

The second step after integrating services using network interactions is to find innovative ways to augment existing services. This can be done by making these services available to new geographic areas using multi-protocol switching networks and enabling access to services with new high-bandwidth technologies such as Ethernet. For example, a Frame Relay virtual private network can be extended to new sites requiring higher bandwidths with Ethernet access circuits while maintaining Frame Relay access for existing sites. Interoperability of services is a key enabler of this, allowing client-edge devices (CEs) to transparently exchange user-level PDUs across different link-level technologies that are terminated at PEs.

Figure 2 shows two methods of service interaction currently under study at MFA and ITU-T. The first is multiservice interworking (known as composite interworking in ITU-T), as shown between PE1 and PE2. A link layer of a single circuit (for example, asynchronous transfer mode) is extended according to characteristics in a multiprotocol switching network, such as ATM PW. PE1 then implements FRF8.2 service interaction [6] between Frame Relay AC and ATM PW's asynchronous transmission mode link layer. Other combinations of Ethernet, asynchronous transfer mode, and frame relay AC and PW can also be used in multiservice interaction scenarios. The advantage of this approach is that any service supported by the service interaction feature can be implemented end-to-end. For example, in the case of asynchronous transfer mode in Frame Relay (FRF8.2), Frame Relay frames are converted to AAL5 PDUs and vice versa as a function of service interaction with an assumed end-to-end applicable service level such as

However, PE1 needs to support the circuit protocol of the remote PE, as well as the associated interaction function for each, as well as feature-based multi-protocol switching.

The second method is the interworking of Ethernet services, as shown between PE1 and PE3. It can be used to distribute Ethernet services to sites connected by asynchronous transmission mode and frame relay circuits. Here, the bridged Ethernet line load is implemented with asynchronous transfer mode and frame relay ACs. An Ethernet PDU is encapsulated in an Ethernet PW similar to an asynchronous transfer mode that propagates over an asynchronous transfer mode network between PE1 and PE3. This extends the Ethernet service level from end to end. The advantage of this approach is that PE1 only needs to support its local link circuits and Ethernet protocols, as well as feature-based multiprotocol switching. This would be suitable for extending existing Ethernet services to new sites with Asynchronous Transmission Mode and Frame Relay channels, however, if the existing network mainly consists of two-point Asynchronous Transmission Mode and Frame Relay circuits and the goal is to upgrade several Ethernet access channels, since the current Asynchronous Transmission Mode and Frame Relay Most networks use routed encapsulation, multiservice interactions may be more appropriate. Alternatively, an IP PW carrying routed PDUs may be used, possibly in place of bridged Ethernet PDUs.

For all service interaction types, the resulting Layer 2 virtual private network scheme is called heterogeneous because the ACs and PWs are of different types.

5 Conclusions

Multiprotocol switching currently has the potential to support a competitive QoS environment. New IP virtual private network (VPN) services also promise new revenue opportunities for service providers.

The intelligent use of network resources and the combination of flexible service deployment have been identified as the most important requirements for providing fault detection and diagnostic capabilities.

The research vision, which aimed to both reduce the number of network nodes that must be deployed and operated, and the time to market for new services, was tailored to new multiservice capabilities, adding features to multiprotocol switching.

The main technical issues reviewed are described in terms of characteristics for the development of new interoperability capabilities of multiprotocol networks and in industry standards bodies enabling the maintenance of service throughput and the introduction of new services.

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