Converged Networks; Their Pros and Cons

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Abstract: Network convergence that unifies network infrastructures is an ideal architecture as a service platform, but can also have its downsides. This paper describes the pros and cons from technical and commercial perspectives.

OCIS codes: (060.4250) networks

1. Introduction

Requirements in terms of access bandwidth and areas of expanded access have been increasing year by year due to the rapid penetration of the Internet for residential customers over the past decade. On the other hand, network solutions for enterprise customers, such as leased line service, Internet protocol (IP) based virtual private networks (VPN) and Ethernet VPN, have been spread rapidly due to diversified service menus with charges having plummeted in recent years. However, although these circumstances reflect success in the info-telecommunication industry, the incumbent carriers are being afflicted by the need for increased investment and continuous cost reduction regarding operational expenditure (OPEX) as well as capital expenditure (CAPEX). The situation now facing the market players fuels efforts to restructure the network infrastructure for efficient operation, administration, maintenance (OAM) and provisioning while maintaining a cost effective service. It is a converged network. To realize a versatile network platform, significant efforts have been made to date by the international telecommunication union - Telecommunication (ITU-T) for anything over the time domain multiplexing (TDM) methodology, such as a packet over SDH/SONET [1] and so on, and by the Internet engineering task force (IETF) for anything over IP and multi protocol label switching (MPLS), e.g. circuit emulation over IP [2] and Ethernet over MPLS [3]. These collaborations by equipment vendors and service providers facilitate the reality of the converged network to solve the issues mentioned above. Although the converged network brings what we expected, in the shape of reduced costs, simplified network architecture and so forth, it is not necessarily only advantageous for commercial service operations. This paper describes the migration of network architecture toward convergence via the cutting-edge of the incumbent carriers in section 2. Section 3 presents some examples of the converged networks and pros and cons, while the service convergence and future issues are explained in section 4. Finally, section 5 presents a summary of the discussion.

2. Background

Network convergence remains an ongoing subject in the incumbent carrier's networks, which mainly comprise the metro-core segment. Network services are created based on customer requirements or a self project of service providers. Therefore, there are various access media and a demarcation device at the customer's site. Here, it is obvious that establishing different network infrastructure is complicated and costly. Therefore, in the metro-core segment, it is preferable for network equipment to aggregate various service traffic and convert protocols to transport or forward the traffic to the customer of the other side traversing the core network.

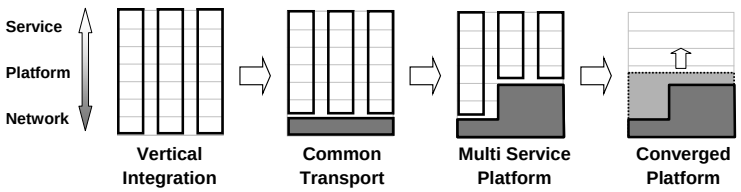

Fig. 1 Migration of a network architecture

Figure 1 shows a schematic view of a typical migration scenario from the initial state of service provision to the converged platform. Although the existence of a vertically integrated service network itself is not a

problem from the OAM&P viewpoint, issues arise when considering multiple provision of services. In this phase, unifying a transport layer, e.g. by wavelength division multiplexing (WDM), add-drop multiplexing (ADM) and so on, involves advanced utilization of a multi service transport platform (MSTP) to reduce CAPEX and OPEX indicated as the second icon in Fig. 1. Even after the integration of the transport layer, there is still complexity of provisioning in discrete operations involving different network equipment. Consequently, the requirement for simplification of provisioning drives further network convergence utilizing a multi service provisioning platform (MSPP). The forth migration is discussed at present moving into an all-IP-based next generation network defined by ITU-T for worldwide interoperability of voice over IP and various IP-based multi service platforms. The motivation of network convergence is intrinsically to reduce costs, even though service providers always seek added value for their customers.

3. Network Convergence

One of the great advantages of a converged network utilizing MSPP is the unification of OAM&P. As reported in reference [4], a multi-service converged metro network was constructed utilizing an RPR based MSPP in 2004. Various requirements designed to accommodate several kinds of interfaces must be solved by a single platform while satisfying their various stringent requirements in terms of service quality.

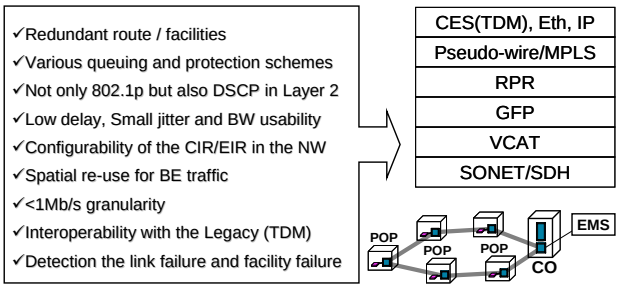

Fig. 3 Requirement and protocol stack of multi-service metro networks

Figure 3 shows the requirements for the multi-service converged metro network and a protocol stack of MSPP equipment. These requirements were a summary extracted from a quadruple play service that contained VoIP, Internet access, IP-TV broadcast and cell phone for residential customers and VPN and TDM based private leased line services for enterprise customers. The great advantage of this platform is the fact that it made available all unified operations that were provisioning services, such as a TDM, bandwidth-controlled packet services with QoS and so forth, and alarm indication from all layers; including the link down of connected edge devices. These unified OAM&P surely reduced OPEX and human error caused by the complexity of the network configuration. On the other hand, the unified platform indicated two particular disadvantages that reflected the tremendous impact of service disruption, not only system failure but also the maintenance thereof, and the difficulty in strengthening the functions in each service.

Network service providers face fresh anguish nowadays. Although the motivation of network convergence and the required network architecture are really quite simple as mentioned in section 2, the reality is slightly difficult and more complicated due to the network construction policies of each service provider.

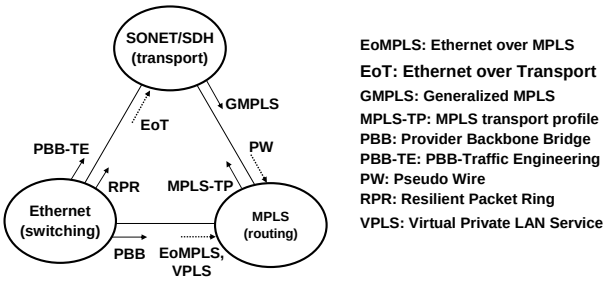

Fig. 3 Various protocols and relationships among existing protocols

The key factor increasing complexity is the fact that the candidates for network construction have increased through progress of networking technology. In other words, it became difficult to point the network layer which should be virtualized in order to construct a converged network. Consequently in fact, progress in networking technology has spawned network diversification, even though service providers need to unify their network infrastructure. Figure 3 shows various protocols used to converge a service network among

existing protocols. The expansion of one protocol creates similar functionalities, which are MPLS-TP and PBB-TE, in different layers. Although an increased number of candidates for network construction is something very positive, caution is inevitable when launching the evaluation of a new protocol which may induce unexpected issues. When realizable services are very alike, the competition of a new protocol needs to consider that it may not necessarily lead to cost reduction, which is a strong demand for network convergence.

4. Service Convergence and Future Issues

Despite strenuous efforts by carriers to ensure network convergence and enhance bandwidth, it seems that the service convergence that they anticipated to date has not yet been realized. Another purpose of network convergence was to reduce the churn rate by facilitating service convergence, which enabled the provision of many services, e.g. triple play, at a discounted set price from a single service provider. However, customer's interest is rapidly switching to services provided online, such as Google and including YouTube, Amazon, Facebook, Twitter and so forth. There are two things which should be learned from these facts. One is that the service trend has shifted from the synchronous to the asynchronous type. The second is that these services are totally independent of network infrastructure at all if the network is IP reachable, and function regardless of the operating system of a computer. While conventional service providers are directing power towards network convergence, the incidence of “service diversity” has transformed IP network thanks to newer service providers. The user experience aspects that a network service provider can improve include network performance, e.g. bandwidth and delay, and expanding the access network to ensure their connectivity to services.

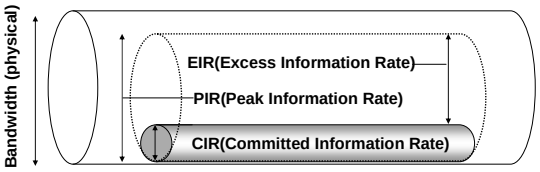

Fig. 4 Conceptual diagram of information rate

In particular, bandwidth-related technologies, such as control and measurement, are set to be vital in future packet centric networks. As shown in Fig. 4, there are two kinds of bandwidth inside a physical bandwidth. One is a committed information rate (CIR) that ensures traffic even if congestion has occurred in a node. The other is an excess information rate (EIR) or peak information rate (PIR), which allows packet traffic to use a physical bandwidth up to the set value if the latter is not used by the other packet flow. Although cost reduction owing to statistical multiplex in a packet network is one of the merits, since the packet loss by network congestion attracts complaints from customers, no network design facilitating the use of the entire bandwidth has yet been realized. However, despite its installation in the network, a bandwidth which is not generating revenue represents dead stock for a communication company. Therefore, one methodology of guaranteeing increased revenue by network convergence in the packet network involves constructing a network infrastructure via a protocol capable of realizing the concept of this CIR.

5. Conclusion

A background of network convergence and the cutting-edge migration of network architectures were explained from the viewpoint of the service provider. The pros and cons of a converged network were described using examples that included the construction of a multi service metro network via our experience. The dilemma of recent service providers regarding unexpectedly diversified service on the Internet was briefly explained. To solve the issue, constructing a network infrastructure via a protocol capable of realizing the concept of CIR to differentiate user experiences and eliminate bad inventory was proposed. The converged network is attractive; however, we must consider its business models for continuous growth.

6. References

[1] ITU-T Recommendation Y.7041 (GFP), Y.7042 (LCAS) and Y.7043 (VCAT)

[2] IETF RFC 4842: SONET/SDH Circuit Emulation over Packet

[3] IETF RFC 4448: Encapsulation Methods for Transport of Ethernet over MPLS Networks

[4] M. Tsurusawa, et. al. “Field Trial of 10 Gb/s Resilient Packet Ring for a Next-Generation Multi-Service Metropolitan Area Network”, NFOEC 2005, NThl2