Chapter 16

ARCHITECTING THE AUTOMATICALLY SWITCHED TRANSPORT NETWORK
ITU-T Control Plane Recommendation Framework

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16.1. INTRODUCTION

Transport networks have traditionally been associated with manual provisioning of circuits for long-duration services based upon a centralized management system for configuration and provisioning. Originally, transport networks were completely manually operated, involving circuit orders on paper along with staff located in equipment stations to both execute the circuit orders (make connections) and locate and repair equipment faults. Each equipment generation has added more to automated network operation. PDH generation networks introduced remote operations, but provided little with regard to integrated management. SDH generation networks provided standards for maintenance features and equipment control, and some network operators even developed automated operational support systems capable of creating hundreds of circuits a day with connection setup taking minutes per connection [1]. This development has been adequate for automating provisioning within carrier-specific operations systems, but did not allow for easy operation between carriers. In fact, after ten years of wide-scale SDH deployment, there is still no existing platform for provisioning connections across multiple operators.

Historically, switched services have been considered as connections that are set up and torn down using signaling protocols, while the setup and
teardown of leased line services was performed via network management protocols. This distinction has been an artifact of the traditional demarcation between transmission and switching. The distinction between switched-services-based and leased line services has begun to blur, partly due to the shortening length of contracts for leased lines, and many network operators and suppliers are developing control plane (see Section 16.2.1 for a discussion of planes) technology for application in transport networks. The goal has been to allow faster service provisioning, particularly between network operators, as well as the creation of new network services [1]. The advent of control plane technology, and associated orientation towards switched connection services, enables fine-grained control of a few specific services versus control of equipment in general. This service orientation facilitates technology independence, and the fine-grain aspect makes it more likely that interworking between carriers will be possible. This is because it is no longer necessary to interconnect all aspects of each carrier’s operations system, but only to connect a single connection service. Utilization of control plane technology, however, does not remove the need for fault localization, performance management, or trouble ticketing. The control plane additionally offers opportunities for increased automation, which has traditionally always led to reduced operating costs.

The application of control plane technology to transport networks has rapidly gained industry momentum, with various standards bodies and industry fora engaged in tackling various facets of this problem space. The ultimate vision is multivendor and multicarrier interoperable networking that supports end-to-end switched connection services on a global scale. To reach this goal, open standards for a distributed control plane must be established. Standardization activities have been under way within the International Telecommunication Union–Telecommunications Standardization Sector (ITU-T), the Internet Engineering Task Force (IETF), and the industry fora Optical Internetworking Forum (OIF) and ATM Forum. The ITU-T started “top down” with the development of the networking requirements for the generic automatic switched transport network (ASTN), working down into detailed protocol requirements. The IETF started “bottom up” in developing the Generalized Multi-Protocol Label Switching (GMPLS) umbrella of specifications based upon modifications and extensions of existing IP-based signaling and routing protocols [2]. The OIF has focused upon developing control plane implementation agreements based upon, wherever possible, available global standards and provides associated interoperability demonstrations with the intent of offering an early testing vehicle for the industry. The ATM Forum has primarily provided feedback and input regarding proposed extensions of protocols within their scope of expertise (i.e., PNNI). Iterative