Vodafone, by mid-2006 had deployed high-speed downlink packet access (HSDPA) services in most Western European countries, providing Vodafone’s 3G subscribers with varied and richer mobile data service experiences. This also ramped up the development of global mobile data services like mobile Internet, music download and online gaming, leading to a marked increase of data traffic.

The mobile backhaul transport network is saddled with increasing pressure from bandwidth limitations. Since 2006, Vodafone has been searching for and verifying new transport solutions. After numerous discussions with leading vendors in the industry, Vodafone gradually settled on adopting the PTN platform to optimize and reconstruct its mobile backhaul transport network.

Many other mainstream parties are highly interested, including BT, DT, Orange, Huawei, Alcatel Lucent, Nortel and Cisco, as well as important standardization organizations like the ITU, IEEE and IETF.

Various solutions and strategies have been put forward after heated discussions. Some questions still remain unanswered: Is the next-generation synchronous digital hierarchy (NG SDH) already at the end of its lifecycle? Which technology is preferred, transport multi-protocol label switching (TMPLS) or provider backbone transport (PBT)? Is PTN now a mature technology?

The solution lies in one two-part question. What is the proper method for enabling the evolution from NG SDH to PTN, and when should it be implemented?

It is now commonly accepted in the industry that compatibility is the key to seamless evolution in the mobile backhaul transport network from NG SDH to PTN. Why?
Seeking for a winning PTN strategy

By Bian Mingang

Service development requirements

The All-IP concept is so popular in the telecom industry that a discussion not based on All-IP is outdated. People have great expectations for All-IP network architecture that can bear services through IP technologies while providing high flexibility and efficiency in service management and control. The All-IP represents a long-term pursuit of service flexibility and controllability.

At present, all talks about the transport platform in the All-IP architecture are based on the assumption that the network will complete its evolution to All-IP very quickly. Many discussions emphasize that IP transformation is actually emergent at all network layers due to the rapid development of data and video services.

Data services have been developing fast over the past few years and in some areas, the annual compound growth rate has been over 300%. Yet, data services have contributed only a small portion to the total revenue of telecom operators. Even in Western Europe, where data services are widely used, the average proportion of data service revenue to the total telecom revenue is less than 15%. An optimistic estimation is that in 2010, data services will contribute to 30% of total revenue. At present, data services might be the only way to stop the average revenue per user (ARPU) from declining. But it is hardly possible that such services will become a major revenue source to telecom operators in the coming years. Therefore, real-time voice services are still vital for telecom operators in the short run and remain a focal point for network optimization and reconstruction.

The trend of service revenue changes indicates that the evolution to All-IP will be a long process. From the perspective of service bandwidth, and after discussions with mainstream operators based on the worldwide development of mobile services and subscribers, we conclude that various granules will coexist for a long time on the

![Fig.1 Evolution trend of various granules](image-url)
access side of mobile networks, as shown in Fig. 1.

Asynchronous transfer mode (ATM) granules will exist for a long time with the introduction of 3G. In 2008 - 2009, the IP radio access network (IP RAN) will be introduced and gradually begin large-scale applications. Later, the IP RAN will bear most mobile data services. The service bandwidth of the GSM network might be slightly decreased as subscribers migrate to 3G networks. However, with GSM/R99 base stations in at least 3 - 5 years, or gradually replace GSM/R99 base stations. Base station equipment of different systems will coexist in mobile networks for a long time.

With the understanding that All-IP is a long-term and complicated evolutionary process, compatibility becomes a basic aspect to be considered in the optimization and reconstruction of transport platforms. Such compatibility involves not only PTN compatibility with TDM, ATM and IP services, but also its compatibility with NG SDH, covering services, network features, management and maintenance. Compatibility is actually the most important feature of the PTN platform.

Results from multiple technology choices

PTN is a next-generation transport platform gradually recognized by the industry after years of discussions. The name indicates two important characteristics: packet and transport. PTN will be a packet-orientated network solution that supports basic features of the transport platform. It will not only enable packet-based switching, flexible broadcast/multicast, flexible QoS control and GE/10GE interfaces, but also realizes end-to-end service management, end-to-end operation and maintenance (OAM), protection switching, synchronization, timing, and native processing of TDM services.

The major technologies that support PTN are: TMPLS, PBT, multi-protocol label switching (MPLS) tunnel control, service encapsulation represented by pseudo wire emulation edge-to-edge (PWE3), as well as IEEE1588 clock synchronization, generalized multi-protocol label switching (GMPLS), and other technologies under development such as OAM and protection switching.

As most of the technologies above are still being considered, they have aroused controversy. Most disputes are about the choice among the three tunnel control technologies, namely, TMPLS, PBT and
MPLS. In 2006 - 2007, after in-depth discussions about technical maturity, compatibility, inheritability and upgrading capability, there is a consensus in the industry that the technologies supporting PTN, have much more in common than differences. The technologies might adopt different processing mechanisms in encapsulation formats and protocol labels, but they realize and support the same network features. Examples include multi-service bearing, end-to-end protection on virtual channels, SDH-like maintenance and management operations. Such features are the transport requirements described in the PTN platform, and they are also basic features inherited from the NG SDH platform.

The choice of technology is closely related to the application scenarios and implementation costs. Whatever technology is selected, the basic standard is that it should be compatible with the NG SDH network while enabling network transport features.

**Need for investment protection**

Many TDM services cannot be discarded during network evolution. In addition to TDM services, existing TDM network resources cannot be discarded either. After the quick development of mobile services over the past few years, most mobile operators have more or less constructed NG SDH transport networks due to the burden of leased line costs. Carriers that lease circuits to mobile operators have built large NG SDH networks.

Other important assets for operators, apart from the physical equipment resources, are actually the end-to-end circuit management and maintenance modes formed in transport networks, their rich experience, and human resources. Then how can operators maximize inheritance of existing resources during network optimization and evolution?

During gradual evolution, SDH-like management and maintenance as well as SDH interfaces will help PTN equipment make minimum impact on the existing network. More importantly, they can be a reserve for the existing management and maintenance modes and teams.

**Most cost-effective evolution scheme**

Network evolution is a long process and many evolution schemes are available. Evolution costs should be the next consideration. Two factors to consider are timing and cost: When will operators start using the PTN equipment? What is the real cost of switching from NG SDH to PTN?

After years of large-scale commercial applications, NG SDH equipment is quite cheap in procurement and maintenance. In contrast, as the PTN equipment adopts a lot of new technologies and is not put to large-scale commercial applications, and as the R&D and trial application costs of vendors are not amortized, costs of PTN equipment are much higher than those of NG SDH equipment. The cost of a TDM E1 in a PTN is 2 - 3 times as much as that in a NG SDH network, and the cost of a GE interface in a PTN is 1.5 times as much as that in a NG SDH network.

The network evolution costs should be calculated according to the service evolution trends. NG SDH and PTN enable TDM/ATM/IP multi-service transport through various technical systems. Due to the differences in the basic technical systems, different costs might arise in different service scenarios. By calculating different scenarios for service evolution, we have worked out the following two cost curves for NG SDH and PTN, see Fig. 2.

The conclusion made by analyzing different scenarios and considering such elements as technical cost decrease and chipset maturity in the future is: When the packet traffic occupies over 70% of the bandwidth, the application cost of PTN will be lower than that of NG SDH. However, this won't occur until 2009 or later.

NG SDH will remain a most important solution in most network applications for 2008 in terms of service requirements and technical costs. But PTN will be gradually deployed in network layers where packet services take a big proportion. Therefore, compatibility of PTN will be of great importance.

PTN construction will result in significant optimization and reconstruction on the existing NG SDH network, or the PTN will possibly replace the NG SDH network. What evolution strategy should be taken to maximally decrease costs during this process?

In long-term network evolution, IP services will gradually become the mainstream granules. TDM and ATM granules will still exist for a long time, although they will be gradually decreased. In a NG SDH transport network, service interface cards account for 60% - 70% of the equipment investment. Whether or not the huge number of TDM and ATM service interface cards configured in the existing NG SDH networks can be inherited in the PTN is one of the most important concerns for the industry.

The service interface cards in Huawei's PTN equipment are compatible with those in the existing NG SDH networks. As a result, 60% - 70% of existing equipment investment can be protected when the NG SDH networks evolve into PTNs. Currently, this is the most cost-effective PTN evolution scheme available in the industry.

**Editor: Liu Zhonglin** liuzhonglin@huawei.com