ASON for Bandwidth Trading

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Abstract

Bandwidth services as they have evolved over the last years can increasingly be seen as a commodity. Multiple network operators have comparable offerings and compete for customers. This fuelled the foundation of bandwidth brokerage and bandwidth trading companies in the late 90s. Unfortunately, their business models where not very successful in the past. Besides the overall economic weakness at the moment we identify some generic and technical reasons for this. Moreover, we show that with novel automation technologies like GMPLS or ASON/ASTN some of these problems can be alleviated. Possible operational models show how future bandwidth brokers or traders could be organised.

1 Introduction

Communication networks have evolved over the last decades to a highly structured system allowing splitting the overall structure in parts, e.g. functional or geographical, that can be handled independently. This separation supported the foundation of organisations that focused on a subset of the whole network. For example an Internet Service Provider (ISP) focuses on a single layer (the IP layer), whereas a city carrier concentrates on a single region. Obviously the structuring requires cooperation of these organisations and at the same time enables competition since the same service could be offered by multiple parties.

A major role in this scenario is played by the transport network layer. Its technology has evolved over the last years to an integrated Optical Network, typically consisting of a traffic aggregation structure based on synchronous time division multiplexing (e.g. SONET/SDH/OTH) operated on a wavelength division multiplexing infrastructure (WDM)

Traditionally, bandwidth was not seen as a commodity (being exchangeable and tradable) and the bandwidth business was bilateral between network operators and their customers. But with the increased bandwidth available, the standardized transport interfaces (i.e. SDH), and the evolving competition network operators started to become exchangeable. This lead to the idea of trading bandwidth like other commodity services, e.g. gas or electricity. In the late 90's companies appeared that offered to trade or broke bandwidth without operating their own network. Unfortunately, with the continuous bandwidth price decline and the weak economy the market did not accept this at that time.

In this paper we show the reasons for the failure of the bandwidth broking and reselling model in the past and analyse how the introduction of ASON/ASTN (resp. GMPLS) techniques will influence the economic basis of bandwidth reselling to a great extent.

For this purpose, in the following sections of this paper we will first give a short introduction to transport networks and the new control plane technologies GMPLS (generalized multi protocol label switching) and ASON (automatically switched optical networks). This is followed in section 3 by an in-depth description of the business scenarios of bandwidth resellers and the rise and fall of the bandwidth trading market. Section 4 then offers an analysis of these market developments and changes to be expected by the introduction of ASON/ASTN concepts.

2 Transport Networks

Transport networks are the basis for packet networks (e.g. Ethernet, IP) as well as TDM infrastructures like the good old telephony networks. Therefore, they have to offer high levels of reliability and predictability. This also contributes to the fact that the transport network operators often are a little bit reluctant to employ new technologies like ASON/ASTN.

2.1 Business Interactions

Transport network operators often have to buy or lease optical fibers from transport and utility companies as the basis of their network infrastructure. The fibers themselves often are quite abundant in today’s infrastructures. Only their equipping with TDM (SDH/SONET) or WDM nodes at the endpoints and corresponding network management systems defines their value. The generated bandwidth is sold to carriers that themselves sell bandwidth in the form of SDH and or packet transfer to customers and retailers, as shown in Figure 1.

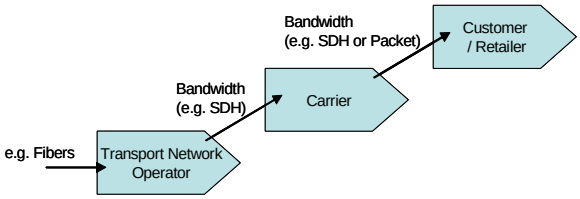

Figure 1 Value system of network operators

The transport network bandwidth market in general is influenced by the following main tendencies:

- Network operators are merging. Either in the form of virtual companies (to extend their reach) or in the form of real merger and acquisition processes.
- Each market player tries to reduce its operational and capital expenditures by delaying network extensions and new investments, by using novel and bandwidth-saving resilience mechanisms, or by redesigning its business processes.

2.2 GMPLS/ASON/ASTN

Optical transport networks are currently operated by centralized network management systems (NMS). These systems enable operators to carry out operation, administration and maintenance tasks, e.g. fault management, configuration management including maintenance of the network (e.g. software updates), as well as provisioning services from a central point. Though these network management systems are well approved, they have some significant limitations. Service provisioning, e.g. for leased lines or virtual private networks (VPNs) may take several weeks since the provisioning processes require a considerable amount of manual configuration and human communication.

To overcome the problems of central network management systems the introduction of a control plane has been proposed. This is currently followed by several standardization activities in the ITU-T, OIF (Optical Internetworking Forum) and the IETF (Internet Engineering Task Force).

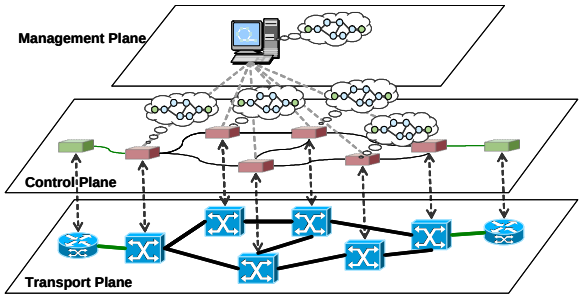

Figure 2 Architecture of control plane based networks

Figure 2 shows the generic architecture of a control plane based network. The switching functionality in the transport plane is controlled by the control plane instances that are part of every network element. The network management system allows carrying out management functionalities based on interactions with the control plane. The bubbles indicate that the control plane instances in the network elements have an overview of the network domain they reside in.

The connection setup is initiated via standardized network work interfaces: The user network interface (UNI) on the customer side and the network-network-interface on the interconnection points to neighboring network operators.

In traditional networks, global network operators have to interact with regional ones to reach the end customers. Setting up the connection takes a large amount of time (up to 6 weeks). This results not only from the fact that the interfaces are not standardized - relying on human work to make connection. Also, the internal routing has to be set up - internal interfaces being also a problem. Setting up a connection between different domains faces compatibility problems and requires several agreements and contracts between the players operating different domains. This proves to be time consuming, labor requiring, and expensive.

Therefore, a more efficient way is needed to make this process faster and automated. Via the introduction of standardized interfaces, new control plane technologies like GMPLS/ASON/ASTN aim to make this possible. However two types of standardization are required:

- Physical standards, making the technologies of different domains and operators compatible.
- Service level agreement (SLA), a service contract between a customer and a service provider specifying the service the customer should receive and it makes sure that, in case of non compliance, the service provider pays damages fees.

Both standardisations would allow operators using GMPLS/ASON/ASTN technologies to deliver fast and flexibly with reduced cost over wide geographical and different regions.

3 Bandwidth Reselling

Generally spoken, a bandwidth reseller is a company having contracts with different network operators. It buys bandwidth from network operators and resells it to clients (retailing); it could also act only as a broker and just manage bandwidth contracts between buyers and sellers. Customers and carriers contact the bandwidth reseller that will allocate them the best connection specific to their needs instead of contacting many

individual network operators to set up the single connection elements. The bandwidth reseller does not necessarily have its own network infrastructure; it cooperates with many interconnected local regional and global network operators and carriers (Figure 3).

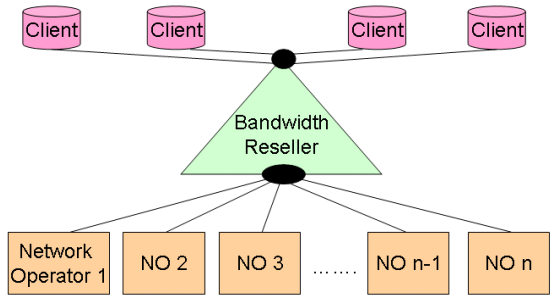

Figure 3 Bandwidth reseller concept

Since the bandwidth reseller uses the connection provisioning services of several network operators, it can flexibly select the best offer to suit a specific connection request. The customers can change easily from one network provider to another looking for better service quality or lower costs connections. And in the case of an available UNI signalling the connections can be torn down and new connections can even be set up without the need for negotiations and long provisioning time.
This means that service holding times (time where a client has a connection through a certain provider) will progressively become shorter, from years and months down to days and even hours. Also, time to service (time for connection set up) will also be getting shorter (few seconds) in order to maintain service profitability.

3.1 Basic Interactions

3.1.1 Interaction between Bandwidth Reseller and Network Operators

The bandwidth reseller buys bandwidth in large scale from network operators. It has framework contracts with those network operators; meaning that it guarantees them that it will buy a certain amount of bandwidth every time period. These framework contracts allow to get the bandwidth for low prices because of volume discount rates the single operators are willing to offer for monthly assured sales of bandwidth.
In another functional model the bandwidth reseller could only be a broker, acting as an intermediary between buyers and sellers. Network operators just contact it offering bandwidth for sale. The role of the broker then would be to find clients for these offers. It is a sort of bandwidth matchmaker that negotiates bandwidth contracts. Counterparties then contract with each other. When the deal is done, the broker earns a commission directly from counterparties.

3.1.2 Interaction between Bandwidth Reseller and End Customers

Prior to connection setup, a contract agreement must be set in place. The end customer and the bandwidth reseller establish a framework contract. Via this contract they specify the allowable range of requests and the bandwidth constraints the client is authorized to ask for in his connections.
Once this paper work is done, the client is granted permission to access the network. It signals its requests towards the control plane of the transport network. The signaling is done via the UNI running between the client and the control plane and allows the user to request connections. The UNI allows the client to perform a number of functions such as Connection Create, Connection Delete, Connection Modify and Status Enquiry.
After verifying the permission to utilize the network and the correct type of connection, access to the transport network is granted and a connection is established with the parameters necessary for the client's application. In this process the client only has a business relation with the Bandwidth Reseller, and does not know which network operator is actually supplying the bandwidth for his connection.

3.2 Access Points and Ownership Models

From the above description of the interaction between the different players, we notice three possible access points:

- Access point to bandwidth reseller: This is the access point for the legal contract agreement between the client and the bandwidth reseller.
- Access point to control plane: Signaling access point.
- Access point to the transport plane: Sending and receiving of data.

Given the three access points, a bandwidth reseller company may show three different ownership models:

3.2.1 Model 1

The bandwidth reseller handles only legal agreements with clients. It is only responsible for buying large amounts of bandwidth from network operators and selling them to customers. The company itself could be a small office, where only few people are needed because the main task would revolve around legal

work and contract making. In this case the Bandwidth Reseller is not concerned with the control plane operation or any access switch that connect clients to the network.

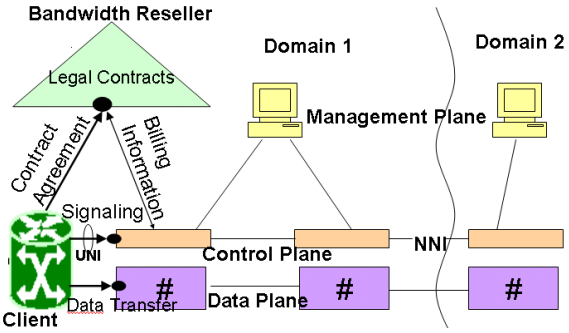

Figure 4 Ownership model 1

The client would directly signal to a control plane operated by the first network operator. In this case the bandwidth reseller would have compensate the network operator for running the signaling access point.

3.2.2 Model 2

The bandwidth reseller is not only responsible for legal agreements but also for operation of the access part of the control plane running it own signaling server.

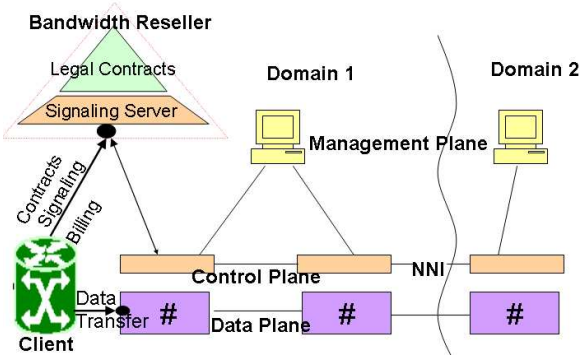

Figure 5 Ownership model 2

On the one hand this requires extra work to be done on the other hand the compensation to the network operator is reduced. The client would the directly signal its transmission request to the bandwidth reseller.

3.2.3 Model 3

The Bandwidth Reseller is responsible for legal contract agreements with clients, operation of the control plane server and its own access switches connecting the clients to the transport network. Having its own access switches, the bandwidth reseller would establish connections of remote regions to the network.

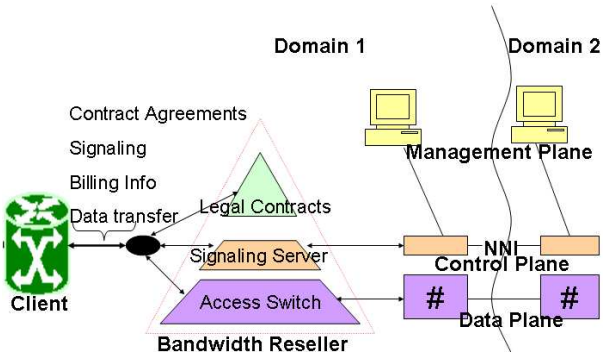

Figure 6 Ownership model 3

More work force is needed in this case: People to run the contract agreements, people to operate the signaling server, and people for the installation, and maintenance of the switches.

3.3 Example

Figure 7 describes a scenario where a source client would like to get connected to a destination client. The client contacts the bandwidth reseller by its UNI and requests a connection setup via the bandwidth reseller. There are two path alternatives for the connection between the client source domain and the client destination domain. One path is through provider C, provider E and provider D whereas the second path goes through provider C, provider B, and provider D. If one of the network operators B or E can offer a better interconnection in terms of cost and quality of service QoS, then the path containing that network operator is chosen.

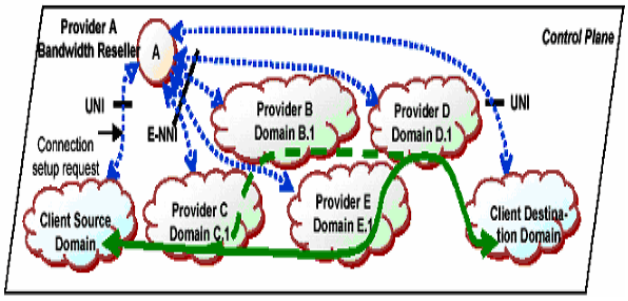

Figure 7 Network model for bandwidth reseller

The customer has only a business relation to the provider A. The signaling information between the bandwidth reseller and its customer may be sent out-of band over an external IP or Ethernet network. The network connectivity must be known to be able to

route the connections request to the client destination domain.
Comparable models are already established in the energy business, where a company acts as a general contractor. The core competencies of such a general contractor are the customer relations management and connectivity service retail. Given the successful trading of gas, electricity and power in the energy industry, it is time for the telecommunication industry to enter this world; and definitely the Bandwidth Reseller will be one of the most attractive business opportunities.

3.4 Rise and Fall of the Bandwidth Trading Market

In the mid 90‘s a new group of companies combining telecom expertise with experience of utility market started offering brokerage and trading services.
In 1997 Band-X pioneered the idea of trading bandwidth, followed in 1998 by RateXchange who offered to link buyers and sellers anonymously. Later in May of that year, Enron announced to the world that it was creating a new market for trading bandwidth. By the end of 1999 other energy brokers began to create their own bandwidth market desk, such as Skura Dellcher, and formed The Association of International Telecommunications Dealers (AITD). In December of that year, Enron completed the world‘s first bandwidth trade. By the beginning of 2000, many carriers were greeting a new era of commodity bandwidth trading. Reluctant at the beginning, deep pocketed energy utility companies Williams, Dynegy, El Paso and Aquila decided to enter the trading market. In May 2000, the first comprehensive index to measure telecommunications bandwidth prices was launched. By September 2000, it was estimated that the BW trading market should will $441 billion by 2005.

Year 2001 was the beginning of the fall: In January, TeleExchange suspended its operation and in March 2001 a 25-30% decrease of BW prices since January 2001 was listed. In June 2001, Bandwidth.com ceased its trading activities and converted to a broker. Since October 2001, 17 companies, with a combined market capitalization of $96 billion went bankrupt. December 2001 was the major turnover: Enron filed Chapter 11 bankruptcy. Seeing Enron falling, other energy merchants ceased trading BW in 2002 and returned to their core businesses: electricity and gas. By March 2002, brokers continued to match buyers and sellers but ceased any trading activity. In October 2002, 47 carriers went bankrupt, trying to compete on bandwidth prices. By December 2002, prices had fallen 44% from January 2001 and weren‘t likely to rise anytime soon.

Starting 2003, people are expecting for bandwidth prices to stabilize. Some even predict positive numbers in the next few years.

4 Analysis

As a summary it can be said that the following effects contributed to the collapse of the BW trading market:

- The decline in the Bandwidth prices induced a glut (i.e. supply exceeding demand) in the bandwidth and made it a product of very low liquidity. This all, made it hard to be considered and treated like tradable commodity. In addition, the collapse of Enron Corp. in fall 2001, made all other utility companies take out themselves from the bandwidth trading market. The bad economical situation made it worse and induced little credit worthy buyers and sellers: Carriers expected a price saving of 15% to 20% before going to broker, other reluctant carriers also feared to loose by selling the excess capacity at bargain prices.
- Another important reason are the long term bandwidth contracts that service providers were stuck to and the very long time to close a contract - usually 60-90 days and more.
- Also, technical incompatibilities between network operators were a major problem due to the nonexistent unified set of quality of service standards.
- Finally, telecommunication companies didn‘t use risk management tools analyzing their exposure to risks and determining how to best handle such exposure This made them blind to the risks of such a volatile market with huge price movements.

Looking a little bit deeper into the matter it becomes clear that the introduction of ASON/ASTN (respectively GMPLS) techniques will change a lot the economic basis of bandwidth reselling:

- Automatic signaling will allow short term contracts since the transaction cost become very small. Also, the time to close a contract will be reduced heavily. The much shorter time frames reduce the financial risks the trading companies are exposed to.
- Standardized Service Level Agreements (SLA) will allow bandwidth to be treated like a commodity complying to sets of unified quality standards: It will be more interchangeable between different operators making it possible to buy bandwidth through future contracts. This will greatly increase the liquidity of bandwidth (i.e. the ability to be converted into cash quickly and without any

price discount). The consequence is a more transparent market in which current trade and quote information is readily available to the public and the price of bandwidth is subject to supply and demand.

- Finally, common standardized interfaces will also assure technical compatibilities between network operators.

Summary

Although almost all bandwidth traders stopped their activities at the moment, brokerage firms are emerging. They work as intermediaries between buyers and sellers. Waiting for the market and bandwidth prices to stabilize, it is only a matter of a few years that capacity trading will catch up again and this time not only energy traders will be involved but all telecom companies will want to be part too, and the control plane technologies like GMPLS and ASON/ASTN will definitely be key players in the technology behind this huge market.

To analyze the Bandwidth Trading business idea, a market study and analysis is necessary. The Bandwidth market evolution during the past few years gives us an indication on how transaction of capacity would be like in the future.

This enables new services, giving the opportunity to consider new business ideas, such as service on demand, dynamic bandwidth provision, and a virtual bandwidth market place. In the future, the virtual market places will enable selling and leasing of bandwidth making room for bandwidth brokerage in the telecommunication industry.

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