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'Bit by Bid by Bit'

Demand and Supply of Bandwidth through Electronic Auctions

Due to the liberalisation of the telecommunications market, the explosive growth of the Internet and its commercial use, traditional business models are not sufficient anymore to provide a representative description of the new telecommunications world. The rise of electronic bandwidth auctions, at which bandwidth services such as international leased lines, voice minutes and IP traffic are traded via a virtual market on the Internet, are an addition to the existing trade mechanisms for international interconnections. For the existence of an electronic bandwidth auction it is essential that at least one of the three parties, be it the supplying party, the demanding party or the auctioneer, gain from it in comparison to traditional means. Buyers and sellers of bandwidth benefit from lower search costs, larger market scope, and greater market transparency and efficiency.

Introduction

For many years, incumbent operators have dominated the market for international leased lines and long-distance telephony. Bilateral agreements, based upon the commonly used accounting rate system, were applied to charge these services. The accounting rate system is now complemented or partially replaced by agreements negotiated at Internet

auctions. Pioneers like Band-X, RateXchange, InterXion, Arbinet, and Min-X are exploiting the Internet by creating virtual markets for the demand and supply of bandwidth services like international leased lines, long distance telephony and Internet protocol (IP) traffic.

The introduction of electronic bandwidth auctions has created a situation where bandwidth (bit) is auctioned (by bid), in an electronic way via the Internet (by bit). This article describes the traditional business of international telecommunications, related trends, and characteristics of electronic bandwidth auctions, such as the situational context, the processes, and the role and added value of a bandwidth auctioneer.

Traditional Accounting Rate System

For the provisioning of international leased lines and long-distance telephony, operators need to interconnect their networks. Interconnection enables customers of a specific operator to communicate with subscribers connected to the networks of other operators. Sea cables, land cables, and satellite links connect the international gateways of operators. In the past, incumbent operators have erected international consortia for the joint implementation of these international links. Commonly, each one of the two involved incumbents 'owned' half of the leg, a so-called *half-circuit*;

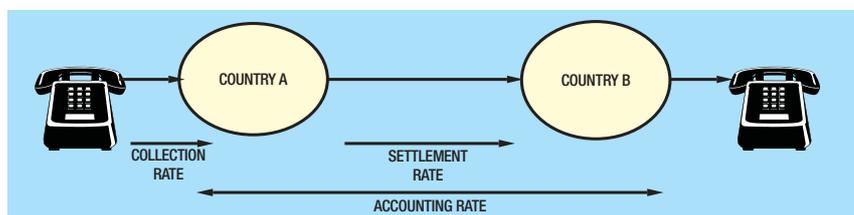
that is, from their gateway up to a virtual midpoint.

Incumbent operators have met, and still do meet, regularly at meetings, like the Global Traffic Meeting (GTM), for the worldwide market, and the Tariff Group for Europe and the Mediterranean Basin (TEUREM), for the European market, to discuss international interconnection. Here, operators negotiate with each other on financial and technical aspects of an international link, covering applied accounting rates, share of revenues and alignment of networks. These agreements usually remain confidential between the two operators, and are not subject to public disclosure: 'The traditional conveyance of international traffic was realised by a cartel-like "club" of corresponding national monopolist operators on the basis of bilateral agreements'¹.

The International Telecommunication Union (ITU) plays an advisory role as a third party, in the making of such bilateral agreements. By means of issuing recommendations on, for example, quality of service and billing methodology, the ITU aims to standardise international telecommunications. These recommendations are formally non-binding, but compliance is aimed for.

Figure 1 gives an explanation of the functioning of the accounting rate system used for the allocation of revenues from international calls. Two operators agree on an accounting rate for making calls back and

Figure 1—Accounting rate system.



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forth. In the case of a call from country A to country B, the operator in A pays the operator in B the settlement rate (often 50% of the accounting rate) to terminate the call in country B. The operator in country A charges its subscriber with a collection rate to cover at least the settlement rate. Periodically, incumbent operators check the balance of incoming and outgoing traffic. An operator with more outgoing traffic should pay the other operator the balance of outgoing and incoming traffic.

New parties, attracted by high margins, have entered the market for long-distance telecommunications. These new players are not bound by the existing accounting rate regime, and regulations have created possibilities for them to interconnect to existing operators. The emergence of competition in this market segment has forced incumbents to reduce their prices for long distance telecommunications. According to Cave and Michie² such a drop in prices was to be expected, as the past high prices of international telephone calls could not be explained by their costs. The accounting rate system is now put under pressure and its future existence is uncertain.

Trends in Bandwidth Trade

Alternatives for accounting rate system

Liberalisation has opened the market for long-distance telecommunications, and new ideas to bypass the traditional accounting rate system were adopted. Mechanisms like least-cost-routing and refile make use of differences between the international rates of different countries. For example, it may be cheaper to route a call from country A to C via B, rather than route it directly from A to C. Differences in international collection rates resulted in the rise of call-back services. A call-back service reverses the origin and termination sides of a telephone call so that the caller is charged with the lower rate as applied within the country of the called person. Furthermore, by means of International Simple Resale, new players bypass public networks by conveying international traffic over a private leased line and terminating it at the public network on the other end.

The Internet has affected the international market in several ways. A current threat for the traditional system is the capability of making

telephone calls via the Internet, which implies a totally different pricing mechanism. Another threat is the use of the Internet as a source of information disclosing long-distance prices, for example, via a spot rate market.

Bandwidth as commodity

In addition to new methods of implementing an international service, market players have extended their transmission capacity by the laying of sea and land cables and by enhancing the used transmission technology. Currently, consortia and companies like TAT-14, FLAG, Global Crossing, Oxygen, and Gemini are laying miles of high-bandwidth optical-fibre cables throughout the world. More flexibility concerning pricing, contract duration and contract types, like rental, lease, future and option constructions, are available now.

The book *The Death of Distance* by Cairncross³ postulates that prices for long-distance calls will drop radically due to the overwhelming capacity available on the international and long-distance networks. Furthermore, the costs for providing such networks have fallen as well. As an example, in the period 1986 to 1996, the capacity on the transatlantic routes between North America and Europe (both cable and satellite capacity) exploded from 100 000 to more than 2 million voice channels. 'Eventually, it will cost no more to telephone from Hollywood to London than to telephone to nearby Beverly Hills'³.

Telecommunication services, and in particular bandwidth services, have become a normal part of life; services are widely available, the number of services has increased greatly, and prices for many services have dropped rapidly. In a sense one can say that bandwidth has become a commodity.

Electronic Auctions

The widespread Internet enables users to create new and innovative commercial opportunities. One of such opportunities is the implementation of an electronic auction. Electronic auctions are already available in various formats: for example second-hand consumer products are auctioned at eBay (www.ebay.com), and bulk electricity is traded between suppliers and users on the Amsterdam Power Exchange (www.apx.nl).

An electronic auction is a specific type of auction that makes use of an electronic infrastructure, in order to form a virtual market where products or services are traded by means of an auction mechanism. McAfee and McMillan define an auction as 'a market institution with an explicit set of rules determining resource allocation and prices on the basis of bids from the market participants'⁴.

Bids and offers

The trade on an auction consists of bids and offers submitted by its users. A bid is a proposal to buy a product or service at a quoted price, according to specific terms and conditions. An offer is similar to a bid but it is now a proposal to sell something at a quoted price. An offer (bid) may be followed by one or more bids (offers), or it may be accepted immediately.

Auction types

Electronic auctions may be clustered by the motives for having such auction⁵. For the electronic trade of bandwidth, the use of an auction for price determination, efficient allocation, and attention and visibility of the bandwidth service is of most importance. For product price determining several mechanisms are available. In an English auction bidders compete with each other by successively increasing the price until only one bidder remains. In a Dutch auction, the bidding process starts with an initial price, which is lowered every certain time-interval until the first bidder accepts the quoted price. In the case of *straight sales*, the first approved bidder gets the deal at the listed price. An auction may also be characterised by its accessibility. At open auctions, bids and offers are made publicly, while the bids and offers at closed auctions are made privately and remain secret⁶.

Klein distinguishes potential objects traded on auctions into three broad categories: commodities, perishable products, and products with a limited availability⁵. For bandwidth, the first two characteristics are applicable. The value of perishable goods will drop to zero at some known point in time, as is the case with unused bandwidth.

Electronic Bandwidth Auctions

Since liberalisation, the number of operators in the long-distance

market has increased, and thereby the potential number of relations and interconnection agreements to be made. The number of relations can be expressed by the formula:

$$\frac{n \times (n-1)}{2}$$

with *n* corresponding to the number of operators. For example, assuming only 15 different operators (incumbents or new operators that need to interconnect to each other) already implies more than 100 bilateral relationships, which will be complicated and costly to manage. As it is now very difficult for all of the operators to find out about each other, it is evident that intermediaries appeared to reduce this clew of interconnections, see Figure 2. Furthermore, as bandwidth is perishable and as it may be regarded as a commodity, bandwidth services are well suited for trade on an electronic auction.

Intermediaries such as bandwidth auctioneers run a location for the physical interconnection of bandwidth auction users (often done via a switch or router), supported by a virtual trade floor on the Internet. Auction users need to have their own physical link or leased line to this location. On the virtual trade floor, an Internet web site, buyers and sellers are brought together. Customers with unused bandwidth or excess capacity on a link from the auction to another specific destination, may offer such services on the virtual market or may search on this market for parties that have indicated to be in need of such capacity. Both potential buyers and sellers are capable of submitting a bid or offer on the virtual trading floor. In this way, a transparent and efficient market is constructed.

Market players

Currently, at least the following players are active in bandwidth auctions via the Internet:

- Arbinet (www.arbinet.com and www.acgn.com),
- Band-X (www.band-x.com),
- InterXion (www.interxion.com),
- Min-X (www.min-x.com), and
- RateXchange (www.rateexchange.com).

Nearly all of these companies are between one and two years old. Their main offices are located in the United Kingdom (Band-X), the Netherlands (InterXion), and the United States (others). However, some already have extended their offices to Asia, Australia, South America and several countries in Europe. Presently their customer focus is on the wholesale market of operators, resellers, ISPs etc. To avoid potential conflicts with their customer base, they generally stay out of the retail market.

Products and services

The most common services delivered by bandwidth auctioneers are the facilities for the trade in international leased lines and voice minutes. For voice minutes the auctioneer's switch will be used for routing the call. IP services, and in particular Voice over IP, are more recent. Depending on their strategies, some auctioneers also deliver their customer supplementary services like negotiation support, clearing of transactions, monitoring of the quality of service, billing, and invoicing. For the provided services, the bandwidth auctioneers commonly charge their customers with a certain percentage of the deal or traded number of voice minutes.

In addition, some auctioneers also offer customers equipment space by means of so-called *carrier hotels*. Customers may use this space to install network equipment for their own purpose.

Users

In order to be able to trade on the virtual trading floor, potential customers should register themselves

for a membership and, in some cases, they have to sign a paper contract in advance. The awarding of a membership gives the user the capability to browse the bandwidth auctioneer's web site for details on the latest bids and offers. Furthermore, the member is allowed to place a bid or offer. Initially, the trading parties are anonymous; however, after having shown interest in a bid or offer, the bandwidth auctioneer may bring the parties involved together. In other cases, the auctioneer will function as an intermediary, with the parties remaining anonymous.

Modelling Electronic Bandwidth Auctions

Kambil and Van Heck⁷ describe a generalised model on exchange processes within electronic auctions, see Figure 3. These exchange processes, split into basic trade processes and trade context processes, are identified as being present in all transactions within electronic auctions. Basic trade processes include the search for product or customers, the valuation of offered products, the related logistic activities, the payment and settlement methods, and the authentication procedures. The trade context processes comprise processes that reduce the risks of trading (that is, predetermined product representations, legal arrangements, influence mechanisms within the institutional context) and a system for dispute resolution. The communications and computing activities within electronic auction environments are the glue between the two different types of processes. Due to the general applicability of this model, here it is used for the modelling of exchange processes within electronic bandwidth auctions.

Search

A party looking for a potential buyer for its offered product or service, or a

Figure 2—Relations between operators via an intermediary.

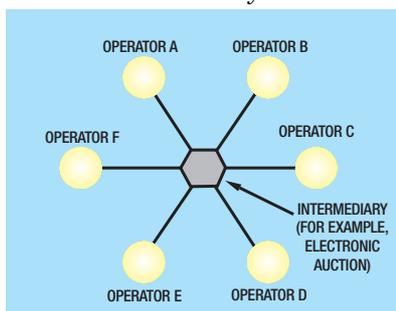
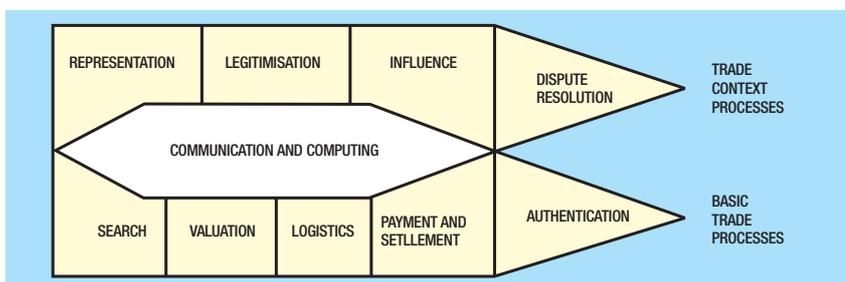


Figure 3—Exchange processes within an electronic auction.



party looking for a selling party which is able to fulfil its own product demands, faces search costs. An electronic bandwidth auction enables a reduction in search costs for bandwidth, as relevant players are present at the virtual trading floor. The measure of success in a match depends on the number of registered users willing to trade and on the number and quality of submitted bids and offers.

Valuation

The valuation of bandwidth can be defined either by the initiating supplying or demanding party. This valuation may be subject to a price negotiation. To inform their users, some auctioneers provide indices to keep track of bandwidth and voice minute prices. These indices may be based upon specific international routes, or on prices settled on the trade floor. The use of an index makes it possible to design future and option constructions for bandwidth. Users can protect themselves against unpredictable variations in future bandwidth prices. So far, auctioneers have not yet implemented such constructions.

Logistics

As bandwidth is an item which is moved electronically, the logistics involved within bandwidth trade are limited to the physical connection of a user's link to the location of the auction's switch or router. Users need to have their own copper, fibre optic or wireless connection or needs to hire a leased line from a third-party operator. The management and configuration of switched or routed links may be considered a logistic process as well.

Payment and settlement

The payment and settlement of closed deals may be done directly between the buyer and the seller, or the bandwidth auctioneers can offer this as an added-value service. In this way, the auctioneer acts as a kind of clearing house.

Authentication

The process of authentication comprises two aspects: the traded services and the trading parties. The authentication of services is concerned with the verification and guarantee of the agreed quality and features of the leased lines, voice minutes or IP link. This aspect is still a difficult issue within the telecommunications sector as good measures

of quality are not available or are hard to guarantee. Common measures for quality are answer seizure ratio (ASR), post-dialling delay (PDD) and voice compression ratio; however, these measures may be insufficient to monitor a link. As the physical route of a service may pass through several operator networks, the applied voice compression ratio may differ along the line and a ratio worse than that agreed may be hard to detect. Some auctioneers guarantee the buying customers the agreed level of quality, but they also have strict demands on sellers offering bandwidth, concerning this issue. The availability of a standardised bandwidth unit may improve the authentication of traded services.

The authentication of trading parties is concerned with the integrity of the customers. In principle, the auctions are available to all Internet users, however, the auctioneers authenticate their customers by means of a compulsory registration, or the signing of a paper contract. In some cases the auctioneer keeps track of a (public) black list of suspicious users.

Communications and computing

The Internet and the web page form the communication and computing fundament for the electronic bandwidth auction. The Internet is the communication path to the auctioneer, while the essential computing power is at the web server site of the auctioneer. Additionally, other (administrative) applications may be used to ease the transactions.

Representation

Representation is concerned with the description of the traded services. To express the type of demanded or supplied service, characteristics like the two end-points of a link, its transmission speed, the compression ratio, and contract duration may be specified. Although these terms are familiar, no global definition is available for a standard representation of such service on an electronic bandwidth auction.

Legitimation

In order to validate a trade between two parties, the bandwidth auctioneer needs to apply some legitimisation method to formalise the deal. Initially, the two parties are kept anonymous; however, after having shown serious interest in each other's bid or offer, the auctioneer generally

brings the two players together for further negotiation and contract making. In general, auctioneers do not publicly disclose any information about the traded deals.

Influence

To ensure fair trade, the auctioneer influences the trade by acting as a gatekeeper and as a guard. To reduce any risk, new entrants to the bandwidth auction have to register themselves or have to sign a contract in advance. Moreover, auctioneers may keep track of a (public) blacklist to exclude unreliable parties.

Dispute resolution

In case of dispute, the bandwidth auctioneer may act as an intermediary, depending on the type of issue. Some auctioneers make themselves responsible for a certain quality of service, avoiding a potential dispute between two of its customers. However, mechanisms for arbitration or legal proceedings, if required, are to be defined within the contract between the parties involved.

Conclusion

Due to liberalisation in the telecommunication market, the traditional way of pricing long-distance telecommunication services is under pressure. The entry of new long-distance providers made this market highly competitive and new service provisioning alternatives, like least-cost-routing, refile, call-back services, and International Simple Resale, undermine the accounting rate system, as applied by the incumbent operators. Several consortia and companies have intensified the laying of high-bandwidth optical-fibre cables throughout the world. Due to the aforementioned, and the progress in transmission technology, bandwidth has become a commodity.

Liberalisation has turned out to be the main driver for the change in long-distance telecommunication services. Supported by the rise of the Internet, it has created new commercial opportunities like the introduction of electronic bandwidth auctions. By bringing potential sellers and buyers of (excess) bandwidth together, such auctions realise savings in search costs for its users. Moreover, it creates a transparent and efficient market for long-distance services like international leased lines, voice minutes and IP traffic.

Besides a virtual market, bandwidth auctioneers offer their

registered members various supplementary services like negotiation support, clearing of transactions, monitoring of the quality of service, billing, and invoicing. In order to ease the trade, to guarantee quality of service, and to enable dealing in future or option contracts for bandwidth, the introduction of some kind of standardised bandwidth unit is recommended.

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Biography



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Kees Hol is a student at the Business Administration department of the Open University in the Netherlands. He is working on a graduation thesis about telecommunications bandwidth sold through electronic auctions. In 1993, he obtained a degree in Electrical Engineering at the Delft University of Technology. He has worked for KPN Research and Siemens, and recently he joined KPN as an international account manager responsible for the sales of Internet services via satellites.