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A profitable multicast business model

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Abstract

One of the main impediments in wide scale deployment of multicast is lack of a good business model. Any technology needs a good business model to succeed. In this article we present a simple business model for multicast in the Internet that uses the inherent benefits of multicast to make it profitable to all the parties, including the multicast sender, multicast receivers and the network providers, that are involved.

Our model is based on the following principle. Multicast receivers should not pay any additional fee for receiving multicast over unicast but might pay for the content, the sender pays for the bandwidth used in multicast to the Internet service provider(s) (ISP) and might charge the receivers for the content. We demonstrate that the use of our model proves profitable to the sender, receivers and the ISPs. We also discuss some deployment issues.

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1. Introduction

Multicast is an efficient paradigm for transmitting data from a sender to a group of receivers. Multicast incurs lower network bandwidth and end-system costs than broadcast to all receivers or multiple unicasts to individual receivers [6]. One of the main impediments in wide scale deployment of multicast is lack of a good business model. Any technology needs a good business model to succeed. Each of the parties involved must see some advantage in using the technology.

In this article we present a simple business model for multicast in the Internet that uses the inherent benefits of multicast to make it profitable to all the parties, including the multicast sender, multicast receivers and the network providers, that are involved. Our model is based on the following principle. Multicast receivers should not pay any extra charge for receiving multicast over unicast, the sender pays for the bandwidth used in multicast to the Internet service providers (ISP) and might charge the receivers for the content. Next, we analyze the sender, receiver and service provider profits. Using our analytical results and the results from the earlier work of Chuang and Sirbu [5], we demonstrate the benefits of our model to all the parties involved. Although we demonstrate the savings available to the sender, receivers and the ISPs using specific results on bandwidth requirements for multicast and certain assumptions about various parameters, our results clearly show that our approach is applicable to other scenarios as well. Last, we also discuss issues related to this model's implementation.

The remainder of the article is organized as follows. In Section 2 we briefly examine the existing work on the subject. In Section 3, we present our business model. In Section 4, we analyze the sender, network provider and receiver profits due to using our business model. In Section 5, we make some interesting observations that arise from our formulation. We construct numerical examples to demonstrate the profitability of our model in Section 6. In Section 7, we discuss important deployment issues. Conclusions and suggestions for future work are contained in Section 8.

2. Related work

A number of proposals to multicast pricing has been proposed by the research community [3,7]. Unfortunately, none of the ideas have been able to fully motivate all the parties involved in multicast including the sender, the network providers and the receivers. Herzog et al. [7] have

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studied the problem of sharing the cost of multicast trees using axiomatic analysis. They find that the only scheme that satisfies all their basic axioms is the one that splits multicast cost among receivers. We believe that receivers should not pay any additional charge for receiving multicast. The 'split edge pricing' model presented in Ref. [3] is related to our work in that it addresses the problem of inter-domain charging. It deals with accounting and charging between different ISPs, but it does not consider the actual cost of multicasting at the intra-domain level. Instead, it proposes to decide on charges between domains in advance, which is different from our business model. Chuang and Sirbu [5], through extensive simulations of over a wide range of networks, have shown that the ratio of links in the multicast tree from a sender to n receiver sites (or POPs) to the average number of links in unicast paths from the sender to n receiver sites is $n^{0.8}$. Phillips et al. [8] have tried to provide an explanation for this result. Chalmers and Almeroth [4] show a different result for the savings of bandwidth by multicast. Based on their experiments and analysis, they claim that the exponent of n varies from 0.62 to 0.73. Our work differs from Chuang and Sirbu's work in the following significant ways. First, we propose how the sender charge could be divided among the network providers. Second our business model clearly identifies the benefits of the sender, the receivers and the network providers. In our numerical examples, we also exploit the region between $n^{0.8}$ and n to provide the benefits of multicast to all parties. Alternatively, we could use the savings claimed by Chalmers and Almeroth, or any other measure of bandwidth savings in multicast [9].

3. Business model

Multicast is inherently beneficial. A good multicast business model should be able to use the inherent benefits of multicast to provide incentives for all the parties involved. In this section we present our business model that meets this requirement. In presenting our business model we use a scenario where a sender is multicasting multimedia data to a group of N receivers, however, we believe that our approach generalizes to other scenarios, as well. The design principles of our business model are as follows:

- Receivers do not pay any extra cost for bandwidth for receiving multicast versus unicast.
- The sender pays for the multicast bandwidth.
- The sender might charge the receivers for the content.
- The network providers should receive revenue based on the proportion of their resources that are used in multicast.

Let us now see how each of the parties involved in the multicast, the sender, receivers and the ISP(s), can benefit by using multicast. As far as a receiver is concerned it does not matter whether it is receiving data through unicast or multicast. Typically a receiver pays a fixed fee to its ISP. There is no incentive for the receiver to pay or share the cost of multicast. A receiver might be interested in receiving multicast if the content is offered free or at a discounted rate when multicast. For example, when a sender sends data to a receiver by multicast, it could charge the sender less than if it were sent by unicast. A sender will be interested in multicast if it makes sure that its data reaches N receivers and by using multicast it pays less than it would for N unicast connections. It can then use a part of this profit to reduce the price of the content. It will be argued later that as the number of receivers increases the reduction in cost due to using multicast over unicast also increases. Hence the sender can afford to increase the discount of the content as the number of receivers increase. This strategy is similar to the one that was used in some online stores that reduced the price of an item depending on the amount sold. A sender could also multicast free content for an Internet radio-like service where it covers the cost of multicast as well as makes profit through commercial advertisements.

There are several reasons why a network provider (ISP, National service provider or NSP) might be interested in providing multicast. First, a service provider uses the same or less bandwidth for multicasting to N receivers than individually unicasting to each receiver. Hence it could offer multicast service at a cost that is less than the cost of N times the unicast cost. One might argue that this will lead to a reduction in revenues for the ISP because it is reducing its business from N unicast connections to one multicast 'connection' that is offered at a lower cost. The argument in favor of multicast is that an ISP can accommodate only a certain number of unicast connections across a bottleneck link whereas it can support an equal number of multicast connections through that link. By charging incrementally more for each multicast it can actually increase revenue since it can serve more customers. In fact, our model shows that an ISP could charge more for a certain bandwidth in multicast than in unicast and still leave room for sender profit. Also, an ISP might need to provide multicast service to stay competitive, and it could use some of its extra revenue to cover its additional costs resulting from implementing and retaining multicast service.

In Section 4 we analyze the profits of the sender, receivers and the ISP when they use our multicast business model.

4. Profit analysis

The symbols used in our analysis are given in Table 1.

4.1. Sender profit

The sender profit due to choosing multicast over unicast can be expressed as follows:

$$X = (Nx_\mathrm{m} - C) - (Nx_\mathrm{u} - Nb_\mathrm{u}) \quad (1)$$

The first term is the sender profit when it uses multicast and the second term is the sender profit when it uses unicast.

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