Title: Solution Approaches for Wide-area Distributed Systems toward Integration of Enterprise Networks and Computing Resources

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Enterprise networks and applications performed over them have been changing according to the enterprises’ strategies for reducing their total cost of ownership (TCO). As a wide area network (WAN) provides high-bandwidth connectivity (i.e., more than several megabits per second), this change has proceeded through roughly three phases. The first phase is the integration of multiple private WANs, as well as computing resources (i.e., servers and storage systems) used for applications in private data centers, e.g., when new enterprises are established through the merger of existing companies after 2000. The second phase is the consolidation of computing resources, such as desktop computers and shared storage equipments, from branches to a private data center, which has become widespread since around 2006. The third phase is the consolidation (i.e., outsourcing) of computing resources from private data centers to public data centers, utilizing cloud computing services, which is currently in progress.

The above integration process involves a lot of WAN issues. Through the first-phase integration, the scale of a private WAN, such as the number of network nodes and end systems, and amount of traffic, increases. We therefore need to consider scalability issues of the private WAN. The consolidations in the second and third phases changes the end-to-end communication path between a client and a server. After the second phase, the end-to-end path is no longer limited to the inside of a branch but traverses the private WAN of an enterprise. Moreover, the third phase results in the end-to-end path traversing a public WAN connecting the enterprise to external data centers. From the perspective of an application executed over the private or public WAN, either WAN could be the bottleneck in the end-to-end path because of its lower performance. This drawback of the WAN could be apparent when the application contains not only bulk data flows but also interactive data flows. On the other hand, from the perspective of the underlying network system, the consolidation of computing resources in data centers results in a greater traffic load on the WAN. In the third phase, when outsourced applications use multimedia data related to digital videos and cameras, this outsourcing will lead to a massive amount of data traversing the public WAN, which will increase the power consumed in the WAN. We have selected several important but not well-discussed issues from those mentioned above, and studied solution approaches for the private and public WANs and applications performed over them. In this thesis, we focus on three objectives, corresponding to the three phases of the integration process, as follows.

For the first phase, we focus on evaluating the scalability of the control plane in a large enterprise network. We develop an approach to estimate the network performance for updating routing information, which is applied to a private WAN.
構築は、2つの大きな銀行ネットワークから始め、我々は次のような方法で行われます。まず、競争的規模効果とデータセントルの設置により、より効率的な選択肢に対するデータセントルの設置が必要です。次に、我々は導入されたテクノロジーや新規ストレージへのインフラストラクチャートの利用を推進することにより、より効率的な選択肢に対するデータセントルの設置が必要です。最後に、我々は導入されたテクノロジーや新規ストレージへのインフラストラクチャートの利用を推進することにより、より効率的な選択肢に対するデータセントルの設置が必要です。さらに、我々は導入されたテクノロジーや新規ストレージへのインフラストラクチャートの利用を推進することにより、より効率的な選択肢に対するデータセントルの設置が必要です。