In this thesis, the impact of multihomed clients and multihomed proxy servers on the performance of modern networks is investigated. The network model used in our investigation integrates three main components: the new one-to-any Anycast communication paradigm that facilitates server replication, the next generation Internet Protocol Version 6 (IPv6) that offers larger address space for packet switched networks, and the emerging multihoming trend of connecting devices and smart phones to more than one Internet service provider thereby acquiring more than one IP address.

The design of a previously proposed Proxy IP Anycast service is modified to integrate user device multihoming and IPv6 routing. The impact of user device multihoming (single-homed, dual-homed, and triple-homed) on network performance is extensively analyzed using realistic network topologies and different traffic scenarios of client-server TCP flows. Network throughput, packet latency delay and packet loss rate are the three performance metrics used in our analysis. Performance comparisons between the Anycast Proxy service and the native IP Anycast protocol are presented. The number of Anycast proxy servers and their placement are studied. Five placement methods have been implemented and evaluated including random placement, highest traffic placement, highest number of active interface placements, K-DS placement and a new hybrid placement method. The work presented in this thesis provides new insight into the performance of some new emerging communication paradigms and how to improve their design. Although the work has been limited to investigating Anycast proxy servers, the results can be beneficial and applicable to other types of overlay proxy services such as multicast proxies.