On the convergence of OSPF

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The Open Shortest Path First (OSPF) [1], [2] routing protocol is the recommended Interior Gateway Protocol (IGP) by the Internet Engineering Task Force (IETF). It is widely deployed in the current Internet and most router vendors support this routing protocol. One of the most important aspects of a routing protocol's performance is its convergence. A routing protocol's convergence is the period during the routers acclimatize themselves to the new network topology after a change in the network. The OSPF routing protocol is a link state routing protocol. It means that every router must have the same view of the network. In case of OSPF, each router must have the same set of Link State Advertisements (LSA) in their LSA databases. When there is a change in the network (e.g. a link goes down), the information about this change is flooded through the Autonomous System so every router can update its LSA database to reflect the new network topology. During this flooding the above stated principle of OSPF is not true (some routers already got the new LSAs, some haven't got them yet) so there can be problems during flooding: rooting loops can arise, networks can become unreachable temporarily. These phenomena could mean degradation of service so it is vital to know how long is this convergence period. In this work the convergence of OSPF was analysed and examined by mathematical tools and by measurements on a test network.

One of the most important aim of this work was to examine the predictability of OSPF convergence from the size of the network. The size here means number of routers and used links. To reach this aim, a model is needed that gives proper measures about the convergence. The first step to get this model is learning how OSPF works and what properties, features and characteristics have effect on convergence. As the convergence depends on the amount of transfered data by the OSPF flooding, the starting point was to see how many data is generated in the relevant flooding situations. Knowing the amount of generated data - i.e. the required bandwith - and the capacity of the network we can predict the convergence. Examining and analysing the frequency of data exchange by OSPF routers, the generated data during flooding leaded to a deterministic model. To validate it, a test network was built and several experiments and measurements were done to see how the model works. The results showed that the deterministic model gives results to be very close to the measured results. To refine the model, a probabilistic component based on measurements was introduced, which led to a better model.

In this paper an OSPF convergence time prediction model is introduced. It is derived from examination and analysis of the generated data by flooding and the behaviour of OSPF. The model was validated and refined by tests and experiments on a test network built for this work. The resulted model can be used to predict the effect and convergence of a change in an OSPF network. This feature is very usable for a preemptive network management.

Keywords: Internet Protocol, Open Shortest Path First (OSPF), convergence

References

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