Evaluation of Fault-Tolerant Multipath Routing in Ad-hoc Network

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Usual wireless networks require base stations to enable communication between terminals, and the communication cannot be made when no base station exists. In Ad-hoc network, network is typically constructed using wireless communication channel, and is interconnected without static access points, such as base stations. In the wireless Ad-hoc networks, terminals communicate each other directly, and computes route by themselves autonomously. An Ad-hoc network that is built with moving wireless terminal nodes is called the Mobile Ad-hoc network. In the Mobile Ad-hoc network, since each terminal moves freely, the topology changes frequently. Therefore, computing the route to the communication peer, i.e., the routing problem, is important.

Various Ad-hoc routing protocols have been proposed in the past. They are classified as reactive protocols, proactive protocols, and hybrid protocols. Reactive protocols calculate routes on demand only when there is a request of communication. Reactive protocols do not send packets if there is no communication request, hence they are efficient in power. However, since it takes time for the route to be determined by the reactive protocol, there is a delay until they can start communication. In contrast, proactive protocols continuously maintain latest updated routes, so that they can provide communicate channels immediately when requested. In order to

achieve this, proactive protocols always send routing control packets periodically, and hence the power efficiency is poor. The last type, the hybrid protocols, switches its behavior between proactive and reactive depending the situations. However, hybrid protocols often require more complex control to switch its behavior, so it is often difficult to perform efficient routing.

As described above, existing ad-hoc routing protocols consider power efficiency and the delay in establishing routes, but few focus on the fault tolerant property. In previous studies, a routing protocol that uses multiple paths is proposed to increase the fault tolerant property. However, studies on the multipath routing is only in simulations, and rarely be implemented. This is because the existing kernel is not intended to be used for multipath, and there is no multipath support that works properly. There is no software that actually works, so it is difficult to test in a real environment. Most studies are evaluated by simulations. However, the simulation can not fully evaluate the fault tolerance or network scalability.

Therefore, in this study, we created a working kernel code for multipath routing. To support multipath, first we need software to handle multipath in the kernel routing table. Existing kernel routing table includes Radix tree, and the routing information is stored in each leaf node of the tree. We added an array to store multi-path routing information, and allow access to the individual routing information specified by an index when necessary. In addition, the Radix tree was replaced with Patricia tree, and the ability to add and remove multipath is added. Patricia tree is a kind of the search trees similar to Radix, and is built more efficiently than Radix tree. So, we can save the memory used in the entire routing table, and also in the arrays when multiple routes are added.

By using the kernel implementation, multipath routing can actually be realized in practice. It became possible to evaluate the fault tolerant property in Mobile Ad-hoc network in a real environment.