Activities in the IETF and IRTF

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The Internet Engineering Task Force (IETF) is an open standards organization, with no formal membership requirements. The mission of the IETF is to make the Internet work better by producing relevant technical documents named Request For Comments (RFC) that influence the way people design, use, and manage the Internet. In particular, the standards focused by the IETF comprise the Internet protocol suite (TCP/IP). We report our activities related to the future Internet technology in the IETF and its sister society, the Internet Research Task Force (IRTF).

1 Introduction

The Internet provides connection opportunities to a vast variety of units and devices for mutual communication. These connected devices include not only routers and servers but also PCs, tablets, and smartphones that are gaining amazingly widespread use in recent years. Many of these devices run different operating systems developed by different vendors. To enable them to communicate with each other, their hardware and software implementations must be consistent with the same communication protocol. One of the reasons behind the ubiquitous use of the Internet as we see now lies in the fact that it has the ability to accommodate a multi-vendor environment. In this context, standardization activities toward establishing world/industry standards play an integral role to ensure mutual compatibility for hitch-free communications among them.

The Internet Engineering Task Force (IETF) is the standards body for standardizing communication protocols used on the Internet, whose mission is to create protocol specifications named Request for Comments (RFC) regarding Internet protocols including TCP/IP. There are very many Internet protocols that fall in the target domain of IETF—from routing protocols to signaling protocols for use in the application layer. To facilitate such activities, it is a general practice to establish working groups within IETF for the discussion of each specific protocol, each of which independently advances deliberations on a specific protocol aiming at compilation of RFC. As the first step toward RFC publication, anyone can author and propose an Individual Internet Draft for discussion by the working group. If the working group acknowledges elements of importance/necessity in the proposed draft, it qualifies the personal proposal as a Working Group Internet Draft for further review, and starts official discussion toward the final objective, i.e. RFC publication. All the discussions take place in IETF meetings that convene three times a year, and through email communications. When the discussions in the working group seem to have reached conclusions, the results are finally verified and compiled into a set of specifications called the Working Group Last Call (WGLC). The outcome is then placed under review of the Internet Engineering Steering Group (IESG)—a group of expert IETF members from a variety of fields—before being transferred to specific procedures toward RFC publication.

RFC is largely classified into two types of documents: “standards track document” and “non-standards track document[2].” The former group includes “Proposed Standard RFC”, “Draft Standard RFC”, and “Standard RFC.” The latter group includes “Experimental RFC” (a specification that is part of some research or development effort), “Informational RFC” (a specification published for general information of the Internet community (not representing an Internet community consensus or recommendation)), and “Historic RFC” (a specification superseded by a more recent specification or considered to be obsolete). In addition, there is another RFC called “Best Current Practice (BCP) RFC”, which is a compilation of technical information considered to be most effective at the present moment, but not qualified as a standards track document. The standards track documents are generally given recognition as industry standard documents. Note, however, that the value of the document in terms of technical worthiness does not necessarily depend on this category. Many of the standards track documents present specifications required to ensure protocol-to-protocol compatibility—e.g. what each bit in a message format means, and how the router should interpret it for taking subsequent actions. Some non-standard track documents also include essential information for technical development, and not every standards track document has been implemented by vendors.

The Internet Research Task Force (IRTF)—a sister organization of IETF—is not a standardization organization. Rather, it focuses on promoting research on such subjects—e.g. communication protocols, applications, and architectures—that may have a profound impact on future Internet technology. In contrast to IETF, it does not seek qualification of the technology/specifications as an industry standard, and places focus on research-oriented activities. Just as is the case with IETF, however, the objectives of IRTF include publication of RFCs. It compiles results from each of the Research Group's activities, and publishes them as an RFC. The RFCs published by IRTF belong either to the Experimental RFC or Informational RFC categories.

2 IETF working group and its activities

Multicast technology is integral to the next generation networks because it has a huge impact on real-time streaming of large-size contents, typically ultra-high resolution videos. Among the IETF working groups, the following two groups are engaged in multicast technology: the PIM working group for the discussion of routing technologies, and the MBONED working group for multicast operation techniques. By the same token, there are working groups engaged in streaming technologies such as: the AVTCORE/AVTEXT working group for the discussion of the Real-time Transport Protocol (RTP) used as a payload header in streaming applications, and the XRBLOCK working group for the discussion of Extended Report (EX) of Real-time Transport Control Protocol (RTCP)—a protocol used in combination with RTP.

In the remainder of this report, we introduce some of the standardization technologies of our own proposal that have attained Working Group Internet Draft status[8][9] and those that have been authorized as RFCs[10][11].

To enable IP multicast communication, IGMP[12] (for IPv4) and MLD[13] (for IPv6) messages are exchanged between receiver hosts and a multicast router, and the multicast forwarding table is maintained by the router. The receiver host, when it tries to participate in a multicast session, sends out an IGMP/MLD Join message (a request to participate) to an adjacent neighbor router. The router, in response to the join message, initiates to create a multicast routing tree if needed. When the receiver host terminates the session, it sends out an IGMP/MLD Leave message, and the router, after receiving the leave message, removes the membership state from the forwarding table and stops unnecessary streaming delivery on an as-needed basis. IGMP/MLD is a soft-state protocol. As such, the router sends out IGMP/MLD Query messages at a regular interval to grasp the latest state of all receivers located on the same LAN. If the multicast receiver status has undergone a change after the reception of a Report (response to Query message) or Join/Leave message, the router must regenerate a multicast forwarding table to reflect the latest membership state. We have proposed a multicast router function, "Explicit Membership Tracking Function[8]," to the PIM working group, applied to IGMP and MLD protocols. This new function is designed to enhance protocol scalability and reduce traffic volume. The Explicit Membership Tracking Function enables the router to store and manage multicast session information (sender IP address, receiver IP address, multicast address, and filter mode) of all the participating receivers located on the same LAN. It then brings IGMP/MLD into a pseudo-hard-state generating an effect of prolonging the Query message timing sent out from the router—thereby enabling the system to reduce message traffic, quickly detect the network on which no receiver exists, and rapid convergence of the membership state.

In the MBONED working group, we have proposed the "Mtrace ver.2[9]" protocol specification. Mtrace ver.2 (hereafter referred to as Mtrace2), now under discussion as a proposed standards track document, which traces and displays the IP multicast routing state: IP addresses of the routers along the route from the downstream network (where multicast receivers are located) to the upstream network (senders are located), as well as state information of the routing tree (Round-Trip Times (RTTs) between the routers, total number of received packets, and so on). The Mtrace2 specification is designed assuming its operability in all types of multicast routers. For this purpose, the specification includes such definitions as: behaviors of the router in a network with firewalls and Proxy routers, and behaviors when encountering a router whose internal information should be hidden (e.g., due to ISP policy). Mtrace2 also brings out an effect for troubleshooting purposes, as well as grasping multicast network topology.

We have proposed two standard track documents in the XRBLOCK working group. Both documents define extensions of RTCP XR messages used to measure the quality of RTP-based streaming. RTCP XR is designed for use in exchange of various parameters between hosts and indicates “Quality of Service (QoS)”, which in turn is used for estimating the “Quality of Experience (QoE)” felt by users. Reference [10] defines the RTCP XR message format used to report Decodability Statistics Metrics—the reporting takes place if MPEG2-TS (Transport System)[14]—for storing MPEG2 data typically used in IPTV—is implemented on RTP. Reference [11] defines the RTCP XR message format, which is used to report Synchronization Delay and Offset Metrics—a set of streaming synchronization information used when the video contents consist of more than one layer, e.g. in Layered Video[15]. In addition to these, many other RTCP XR message definitions have been proposed in the XRBLOCK working group, and some of the specifications have already been published as RFCs. Their widespread use will enable provision of streaming services with quality that satisfies users.

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