Chapter 4
Inter-Domain AOM and Incremental Deployment

Abstract This chapter studies the rest of the practical design issues of AOM service model, including asymmetric inter-domain routing, forwarding loops prevention, and incremental deployment. In Sect. 4.1, we propose to incorporate BGP routing information to the RPF concept to address the asymmetric inter-domain routing issue, which avoids the deployment/configuration complexity of MBGP and enables a fast group joining mechanism. The false-positive property of Bloom filter can incur forwarding loops in the Bloom-filter-based multicast protocols. In Sect. 4.2.4, we analyze the effect of false positive on our most closely related work FRM. The theoretical upper bound on loops in AOM is given, and it is proven that AOM is able to automatically eliminate the forwarding loop caused by the Bloom filter false positive. Section 4.3 describes an incremental deployment solution for AOM. AOM can work over a network, in which only a small fraction of routers have AOM-aware intelligence while others are legacy routers. Extensive simulation results over a practical topology are presented in Sect. 4.4 to demonstrate the outstanding performance of AOM, with comparison to classic IP multicast and FRM. This chapter is summarized at the last section.

4.1 BGP-View-Based Joining Process

The essence of the joining process described in Sect. 3.3.2 is to construct a SRC-based reverse SPT, which requires the path from the SRC to a RDR is symmetric to the one used to go from the RDR to the SRC. Nevertheless, the inter-domain routing is usually asymmetric because of administrative reasons [8]. In Fig. 4.1, it is possible that the MUM sent by $E$ takes the path $E-C-A$ to reach $S$, while the downstream data path is $A-B-E$. We note that an alternate option might be to use the Multiprotocol Extensions to BGP-4 (MBGP) [1, 2, 8] announcing different
unicast- and multicast-capable routes, which enables the MUM to take the correct joining path up to the SRC; however, this introduces the deployment and configuration complexity of MBGP [1, 8] which we intend to avoid.

4.1.1 Revisiting the Basic Design of AOM

The basic design of AOM proposed a round-trip join message solution to deal with the asymmetric routing challenge in Sect. 3.4.2. Figure 4.1 shows an example of AOM joining process in the asymmetric routing scenario, where the MUM takes a round trip to set up an IRDR_BF at appropriate router interfaces. The MUM message is first unicast to the SRC in the same manner described previously; however, the data packets from the SRC to the RDR may follow a path that is different from the upward-MUM-established path for some administrative reasons [8] (e.g., the link between A and C is not allowed for multicasting). In this case, besides forwarding the MUM to the SRC, the SDR further passes the MUM along the path the downstream data packets will actually take so that the links multicasting traffics to traverse are labeled with corresponding IRDR_BFs. As an extra step, the RDR then