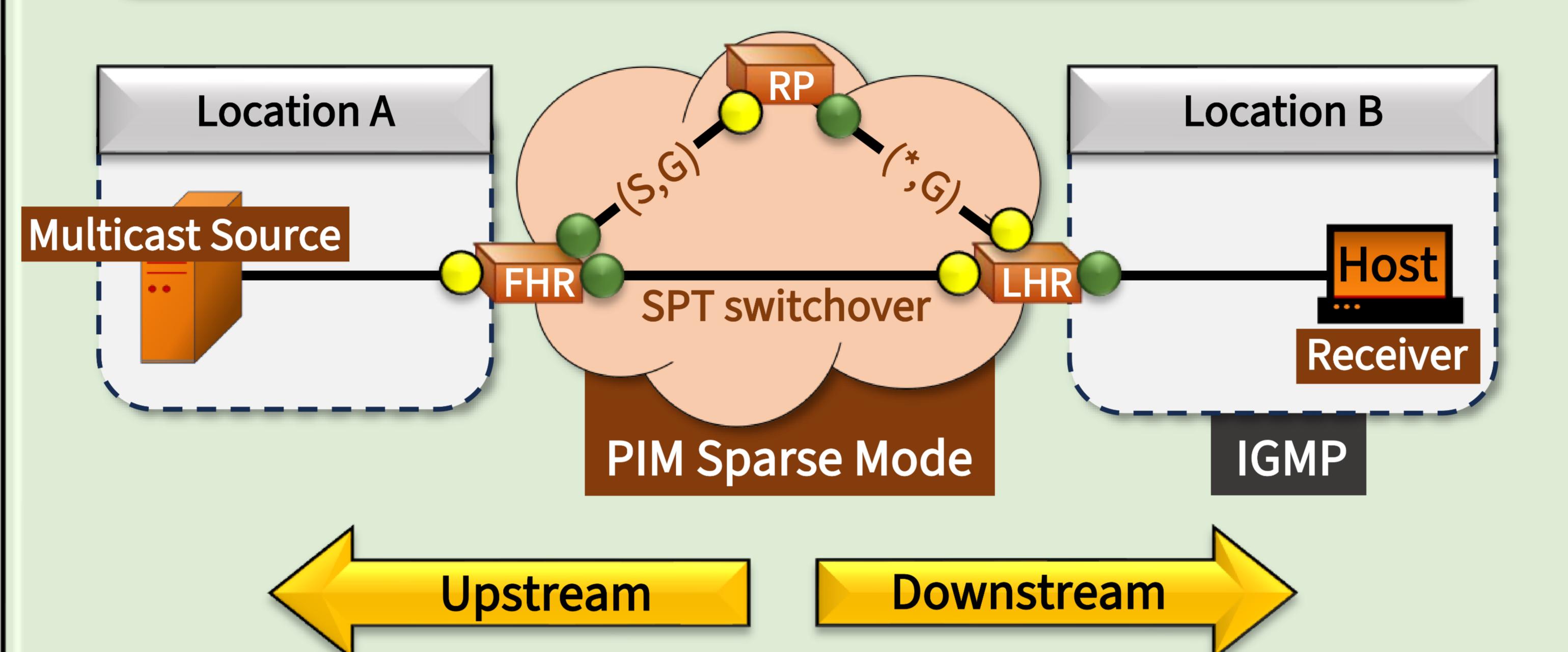
Introduction to Multicast

Multicast is a form of network data transmission destined to a particular group of devices that have opted to receive a multicast stream. Receivers of a multicast stream join a multicast group by using IGMP (IPv4) or MLD (IPv6). Meanwhile, Protocol Independent Multicast (PIM) ensures signaling and loop-free delivery of the multicast stream across a routed network. A multicast stream has a unicast source address, and is sent with the transport protocol UDP. Multicast optimizes network resource utilization in comparison to unicast and broadcast.

- Outgoing Interface List (OIL) the Receivers of a multicast stream are reachable through the OIL, selected because of IGMP or PIM join
- O Incoming Interface (IIF) single interface used to reach the Source or the RP, also called the Reverse Path Forwarding (RPF) interface



Important concepts in PIM Sparse Mode architecture

- PIM periodically sends Hello messages on PIM-enabled interfaces to establish directly connected neighbor adjacencies required for PIM Join/Prune process and for the RPF validation. The Designated Router (DR) election also uses Hello messages which are sent to 224.0.0.13 the All PIM Routers multicast address.
- FHR First Hop Router, the PIM-enabled router closest to the multicast Source, in PIM Sparse Mode (SM) the FHR initially transmits unicast packets which encapsulate (tunnel) the multicast PIM Register message destined to the Rendezvous Point in order to establish the Source-Based Tree (S,G).
- RP Rendezvous Point, is necessary for PIM SM, the RP connects the (S,G) tree with the Shared Distribution Tree (*,G). The (*,G) tree is initiated by the Last Hop Router (LHR) and has the RP at its root. The RP switches traffic arriving from the FHR on the (S,G) and destined towards the LHR on the (*,G) tree.

PIM SM devices have 3 methods to learn the multicast group-to-RP mapping:

- 1. The RP can be statically configured, however this is not scalable.
- 2. Auto-RP can be used which includes a Mapping Agent. Auto-RP requires PIM Sparse-Dense Mode or auto-RP listener function to flood RP address.
- 3. Bootstrap Router (BSR) can be used, an open standard, requires PIMv2.
- LHR Last Hop Router, the router closest to the Receivers of the multicast stream. Each receiver signals its intent to join a multicast group by sending IGMP Membership Report messages on the local LAN segment. The LHR receives the IGMP messages, and transmits PIM Join messages (*,G) to the RP.
- SPT switchover Shortest Path Tree switchover is an optimization mechanism triggered after the RP has connected the Source's multicast stream (S,G) with the LHR (*,G). SPT switchover is initiated by the LHR which creates an (S,G) tree directly with the FHR without using the RP. This may change existing IIF/OIL.

Other PIM modes of operation

FIM Dense Mode – treats a multicast tree as a broadcast network, floods multicast stream to every PIM-enabled router, devices not interested in the stream can prune (remove) themselves from the distribution tree. Also called a push-and-prune mechanism and is less efficient than PIM SM. PIM DM only uses Source-Based Trees (S,G).

PIM Sparse-Dense Mode – used with the Auto-RP functionality, operates in Dense Mode (DM) so that the PIM-enabled routers can locate the RP, and when the RP is located the network switches to PIM Sparse Mode. Downside, if RP is not reachable then fallback is PIM DM.

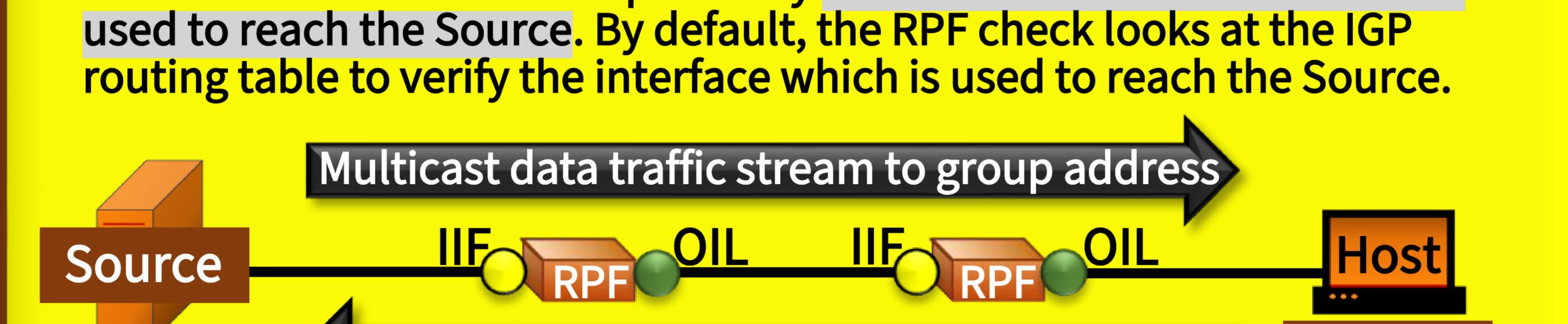
PIM Source-Specific Multicast – this is a form of PIM Sparse Mode (PIM SM), however PIM SSM does not require an RP because the LHR only creates Source-Based Trees (S,G) with the FHR. This requires IGMPv3 on the Receiver which must know the multicast Source address.

Bidirectional PIM Mode – this is a form of PIM Sparse Mode that only creates Shared Trees (*,G) with the RP at the root. There are no Source Trees (S,G) created and this improves network scalability. Multicast streams are always transmitted through the RP and there is no SPT switchover. Thus, RP placement and redundancy is important.

Possible RP redundancy method with Bidirectional PIM is Phantom RP.

Reverse Path Forwarding (RPF)

RPF is used for loop prevention in PIM. Multicast traffic from the Source



Control plane traffic (PIM) builds reverse path

destined to the Host is accepted only if received on an interface that is

Receiver