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FEATURE BRIEF: MULTIPOINT SECURE VECTOR ROUTING

Introduction

Applications such as Internet Protocol Television (IPTV), financial market data, conferencing, gaming, corporate broadcasts, and collaborative computing require simultaneous communication between groups of participants. With IP Multicast, applications can send one copy of each packet and address it to a group of receivers rather than a single receiver. It is the responsibility of the network to forward packets to only the hosts that need to receive them. Multicast is a bandwidth conserving technology that reduces traffic by sending packets only once over shared links while delivering it to a large number of receivers.

The protocol used by receivers to join a group is Internet Group Management Protocol (IGMP) or Multicast Listener Discovery (MLD). Once a receiver joins a particular IP multicast group, a multicast distribution tree is constructed for that group using Protocol Independent Multicast (PIM), Bit Index Explicit Replication (BIER), Multipoint Label Distribution Protocol (mLDP), Point-to-Multipoint Resource Reservation Protocol – Traffic Engineering (P2MP RSVP-TE), or other tree building protocols.

While IP multicast has seen success in many areas, multicast services are generally not available to end users. Some reasons for this lack of widespread deployments are:

- Traditional multicast protocols and network solutions impose a great deal of complexity on the network.
- Tree Distribution protocols require all routers in the domain to understand multicast.
- Multicast exposes the network to a far greater attack surface with vulnerability to denial-of-service attacks.
- Multicast VPN and other support from intermediate providers have a long turn up time.
- Low-cost white boxes do not support traditional multicast forwarding in hardware.

Any successful multipoint distribution mechanism must:

- Reduce complexity and dependence on other routing protocols.
- Easily deploy within existing networks.
- Remove provider dependency.
- Provide inherent Zero Trust Security (ZTS).
- Work with low cost hardware.

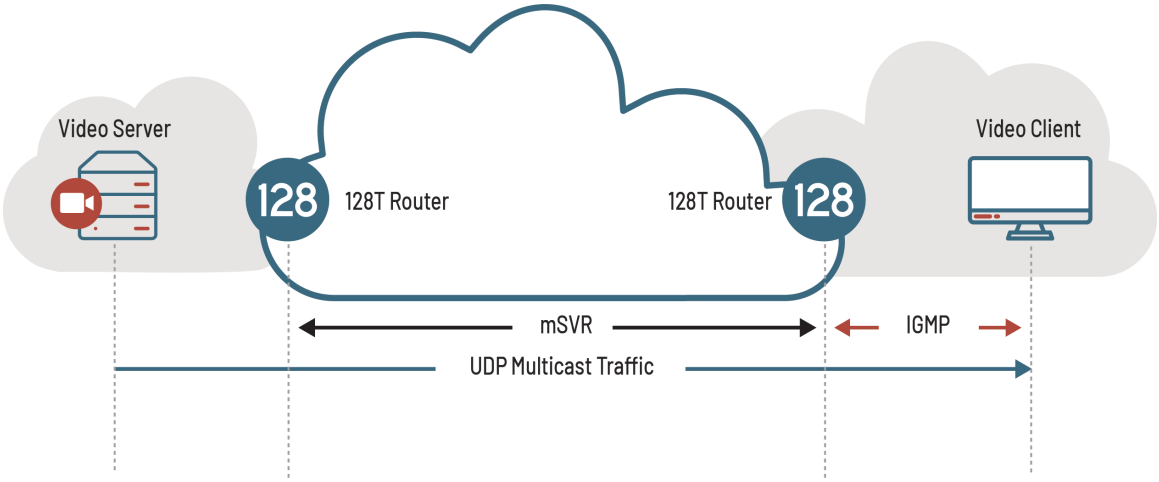
Multipoint Secure Vector Routing

The 128T Session Smart™ Router provides a multicast solution by utilizing Secure Vector Routing (SVR) technology to establish Multipoint SVR (mSVR) sessions between participating 128T Session Smart Routers. This enables multicast behavior in the network, sending packets intended for multiple receivers only once over shared links.

mSVR removes dependency on complex traditional multicast tree building protocols such as PIM and on hardware dependent protocols such as BIER, mLDP, and P2MP RSVP-TE. The underlying infrastructure does not require any previous knowledge of multicast so it will not be constrained to any multicast domain which is common in current implementations. Session stitching and replication ensure efficient delivery of the packets. This is a huge improvement over existing complex multicast delivery mechanisms.

Joining a Multicast Group

IGMP operates between the client receivers and a local multicast router. IGMP is implemented on a particular host and within the 128T Session Smart Router. The host requests membership to a group through its local router while the 128T Session Smart Router listens to these requests and periodically sends out subscription queries. A single 128T Session Smart Router per subnet is elected to perform this querying function.



The 128T Session Smart Router implements IGMPv3. IGMPv3 is backward compatible so the 128T Session Smart Router is able to support clients running IGMPv1, IGMPv2, and IGMPv3. No changes will be required on clients when relying on 128T Session Smart Routers in the network for multicast.

MLDv2 provides analogous functionality to IGMPv3 for IPv6. The 128T Session Smart Router will support this for IPv6 mSVR. Due to the inherent nature of SVR using waypoints for routing by separating the endpoint addresses from the routing addresses, the 128T Session Smart Router will be able to support IPv6 mSVR over existing IPv4 cores. This enables applications and sites to seamlessly migrate to IPv6 without having to depend on the core network to migrate to IPv6.

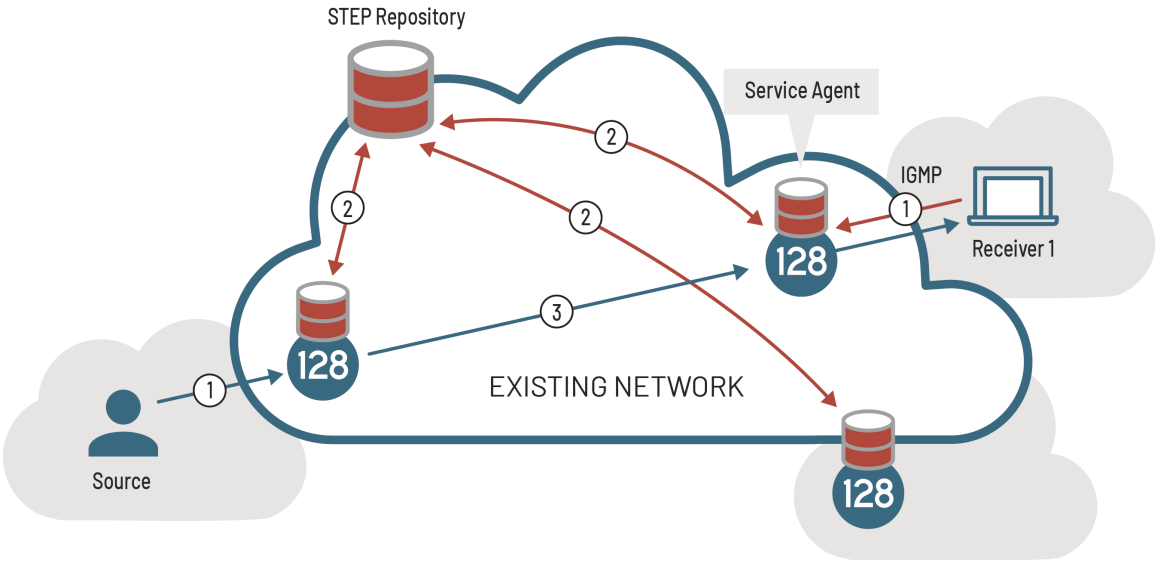
Setting Up the Multicast Tree

The 128T Session Smart Router provides a multicast solution that leverages the Service and Tenancy Exchange Protocol (STEP) and its Service Exchange process for establishing the multicast distribution tree, providing high-speed dissemination of policy, paths, and participants among 128T Session Smart Routers in a network.

Using STEP enables the existing underlying network to have no prior knowledge of any multicast protocol and no routers in the domain are required to understand any specific protocol. When a new receiver or source expresses an interest to join or send to a multicast group the following actions are taken:

1) When a new receiver expresses interest to join a multicast group using IGMP,
   a) If the 128T Session Smart Router has not received packets for this multicast group it creates a service agent or equivalent to indicate that it has interested receivers.
   b) If the 128T Session Smart Router is already receiving packets for that multicast group it starts replicating packets to the new receivers who have joined the group.

   The order in which sources and receivers join or leave the group do not change the multicast behavior.

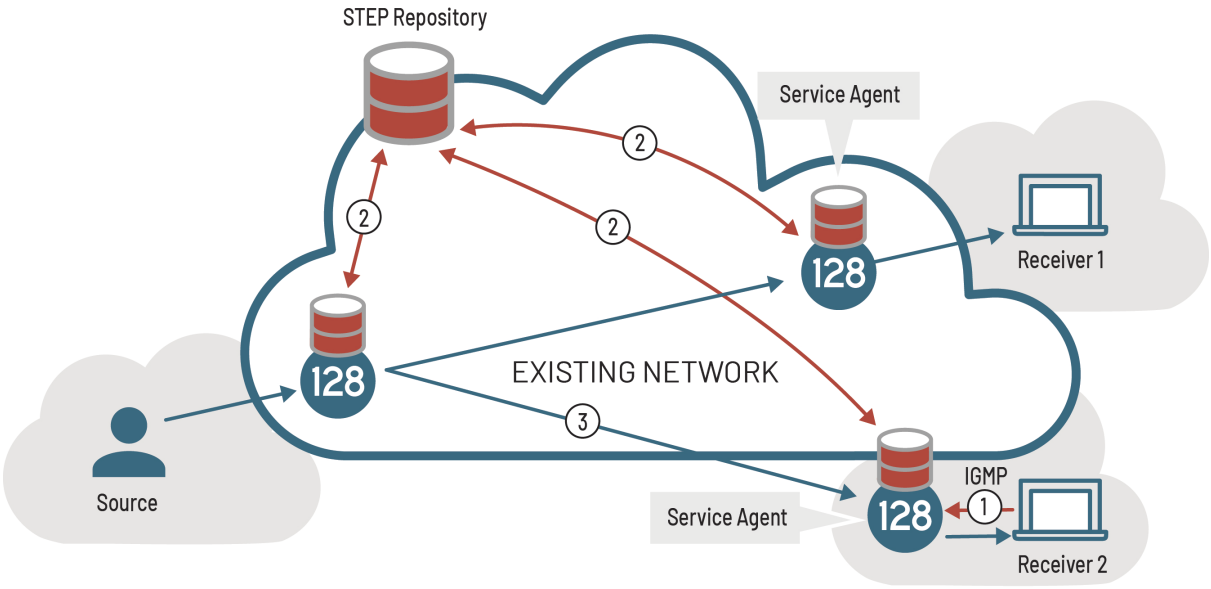


2. When receivers join or leave a group, the STEP registry updates the 128T Session Smart Routers in the domain of the change in participants. The 128T Session Smart Routers decide based on this when and where to forward packets to the particular multicast group. If a 128T Session Smart Router already knows the source for the multicast group then it can directly join the source instead of waiting for a STEP update to propagate.

3. When a source sends packets to the multicast group, the 128T Session Smart Router checks to see that it is a valid source and it is authorized to send packets. If it is a legitimate source then the 128T Session Smart Router sends the data to all service agents using mSVR. If there are no interested service agents then the packets are dropped.

Joining an Existing Multicast Tree

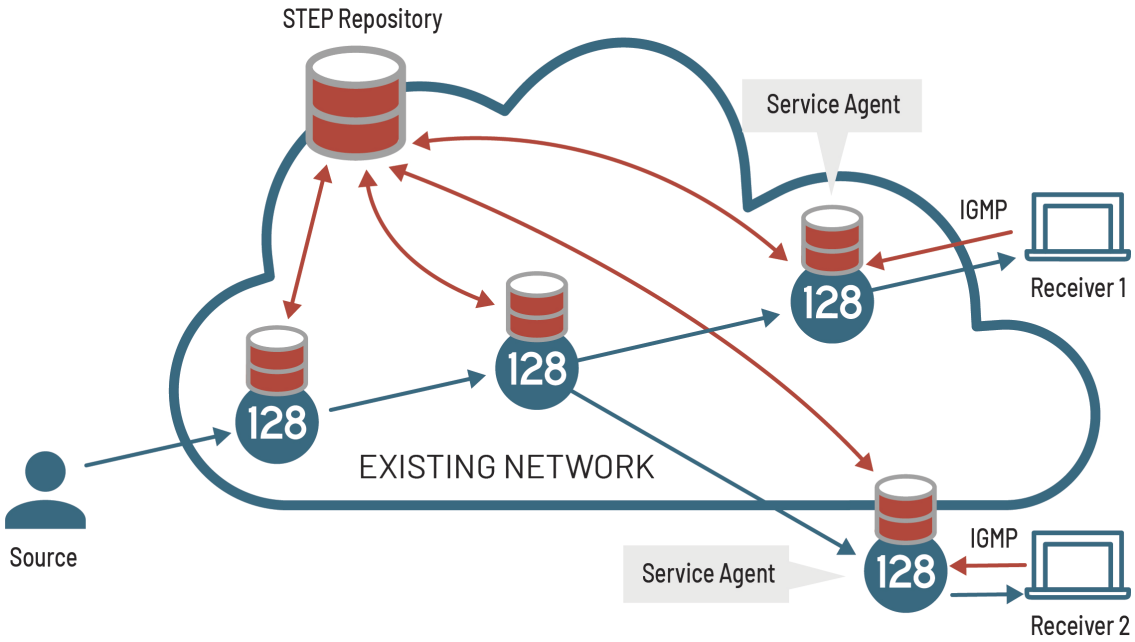
The 128T Session Smart Router allows new authorized receivers to join an existing multicast distribution tree. When a new receiver sends an IGMP to join a process similar to that to set up, the multicast tree is followed. A 128T Session Smart Router that learns of a change in group participants starts replicating existing flows to the new participants.



Replication

128T Session Smart Routers only replicate sessions to downstream participants. This ensures that as routers are added to the network, the multicast distribution tree remains optimized. If there are multiple receivers, session replication ensures that fan out routers on shared links only send information once. For large scale deployments, it is beneficial, not mandatory, to include additional 128T Sessions Smart Routers at vantage points to ensure that the multicast distribution tree is optimal.

This is akin to setting up Rendezvous Points (RPs) in traditional PIM-Sparse Mode deployments. The general trend in the industry is to move towards PIM-Source Specific Multicast or BIER as in most deployments (other than Telepresence) the number of sources is very low in a multicast group compared to the number of receivers.



Multiple Sources

When there are multiple sources or when there are sources who are also receivers (like in Telepresence applications), the 128T Session Smart Routers will ensure that the packets received are only forwarded to downstream receivers and never to 128T Session Smart Routers who are upstream.

Leaving a Multicast Group

When an IGMP leave message is received by a 128T Session Smart Router, it checks to see if there are any other receivers downstream. If there are no receivers downstream then it removes the service agent if it is an edge device and/or stops replication of the multicast stream downstream along that path. STEP propagates this change to other 128T Session Smart Routers to ensure that the multicast distribution tree is pruned appropriately.

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Aggregating Participants

The 128T Session Smart Routers only issue updates to service agents when a new participant joins or when all participants leave. This is done to ensure that new updates are not generated for all membership changes but only when new locations need to be added or removed from the multicast distribution tree.

Summary

The 128T Session Smart™ Router provides a multicast solution that extends session based routing capabilities to multipoint session based routing. This unifies the OAM, signaling, and protocol extensions with unicast. It does not require the deployment of any complex tree building protocols in the network.

mSVR can be incrementally deployed either only at the edges of any existing network or at edges and vantage points in the network to build an efficient multicast distribution tree. The Services and Topology Exchange Protocol (STEP) ensures that the tree is always updated and replication is only performed to interested participants.

Session replication and session stitching ensure high performance instantaneous distribution of multicast data. The performance of session replication is similar to that of unicast forwarding performance. Incremental STEP updates through the repository are blazing fast with hundreds of changes taking milliseconds to update. The 128T Session Smart Router provides a multicast solution that is a seamless replacement for traditional multicast tree building protocols and can coexist as the network moves towards a modern approach.