Software-Defined Multicast Network Overlay Framework

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David Qi, Bloomberg
Nabil Bitar, Nuage Networks/Nokia
Truman Boyes, Bloomberg
Senad Palislamovic, Nuage Networks/Nokia
Anil Lohiya, Juniper

Outline

- Problem Statement
- Requirements
- Proposed Framework – SDN Multicast Framework
- Next Steps

Problem Statement – Today's Multicast Solutions

- P1: Network scalability, stability and impact on unicast with limited operator control
  - Distributed (on-router) multicast control plane shares compute resources with unicast
    - Multicast receiver Joins & Leaves
    - Periodic Multicast state refresh

- P2: lack of uniform multicast admission control mechanisms and path computation constrain support across implementations
  - Based on entitlement of receivers and senders
  - Based on bandwidth in path computation, when it applies, and at nodal level
    - With IP multicast data plane or non-TE signaled paths, there is no bandwidth control capability
  - Based on operator network design policies on resource usage
  - Based on QoS constraints (e,g., latency, jitter) – often not accounted for

- P3: Restrictions and constrains that limit the ability to carry multicast traffic across "network domains" with different multicast capabilities
  - Network domains may be part of same or different ASs and/or operators

Problem Statement – Today's Multicast Solutions

- **P4: Inability of operator(s) to flexibly design multicast (inter-) networks coping with operations' requirements and underlying network capabilities**
- **P5: Lack of uniform security policies and mechanisms to protect against various DoS attacks in control or data plane**
- **P6: Lack of multicast telemetry data**

Multicast SDN Overlay Framework

- **Objective: Define a reference architecture and framework that ease the development of interoperable solutions that address today's problems**

- **Genesis: SDN Paradigm**
  - **Provides for the decoupling of the multicast control plane from the routing forwarding elements and unicast control**
  - **Unified control plane across the various forwarding element implementations**
    - **Uniform admission control (entitlement and bandwidth)**
    - **Multicast tree computation algorithms that can take into account various constraints**
  - **Multicast SDN Domain controllers for scale and extending multicast control across domain boundaries with different capabilities and administrative responsibilities**
  - **Management Applications that can control the additions of receivers, senders, and steering of traffic**

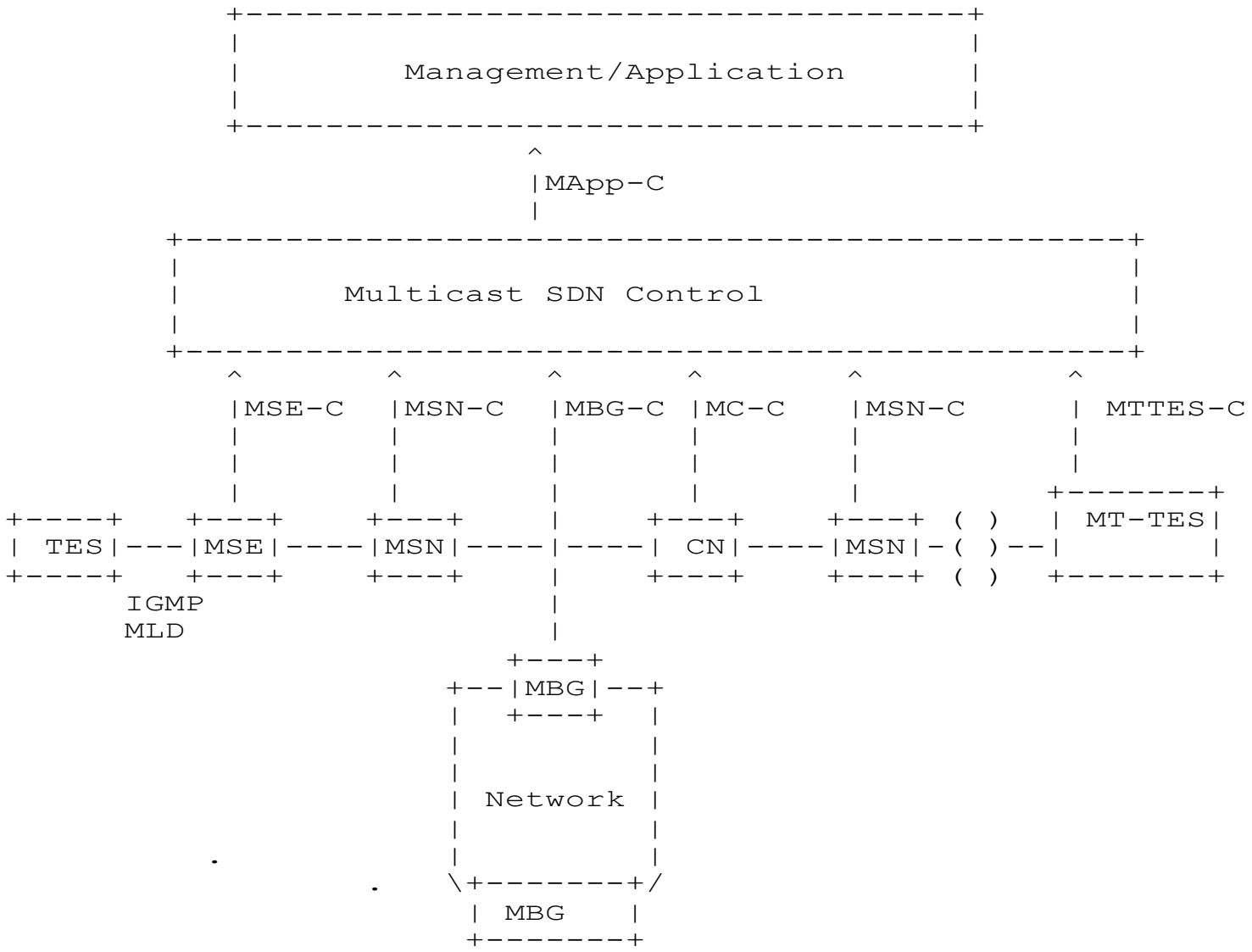
Multicast SDN Overlay Framework – Key Requirements Addressed (1 of 2)

- No network topology constraints, but unicast and multicast topology aware (resources, capabilities)
- Decouple unicast and multicast topologies - select replication nodes and types
- Agnostic to other services in network (unicast and multicast)
- Support existing multicast applications – no modifications required
- Support for multi-tenancy (implications to both control plane and data plane)
- Support for edge replication over underlay unicast data plane transport. Underlay unicast transport:
  - IPv4 and IPv6
  - MPLS
  - Segment routing
- Support for edge replication over underlay multicast data plane transport. Underl unicast transport:
  - IPv4 and IPv6
  - MPLS
  - BIER

Multicast SDN Overlay Framework – Key Requirements Addressed (2 of 2)

- Admission Control (entitlement and bandwidth)
- Path (re-) computation based on various constraints
- Programmability of network elements – policies and multicast forwarding entries
- Stitching of multicast traffic across different multicast domain boundaries with different capabilities

Multicast SDN Overlay Framework Reference Architecture (1 of 3)



Multicast SDN Overlay Framework Reference Architecture (2 of 3)– terminology and functionalities

- MSD (Multicast SDN Domain): under the control of one multicast SDN controller in ne admin domain
- MSE (Multicast Service Edge):
  - Multicast on LAN ports (control and data plane replication)
  - Proxies multicast joins/leaves to SDN controller
  - Receives/sends multicast packets, unicast-encapsulated from/to designated MSNs
- MSN (Multicast Service Node): Designated multicast replicator for MSEs with senders and/or receivers for a multicast group. Replicates and receives multicast packets from other MSNs and MBGs.
- MBG (Multicast Border Gateway): Interconnects MSDs
- CN (Core node): provides transit underlay transport

Multicast SDN Overlay Framework Reference Architecture (3 of 3)– Models

- Full: SDN Controller performs all control plane functions and programs the data path all nodes in an MSD – Draft provides an operations overview
- Hybrid:
  - Admission control and programmability of MSE-MSN data pathand multicat group membership on MSN by SDN controller
  - Distributed control plane on MSNs and MBGs (BGP-MVPN) in an MSD
- Cut-Through:
  - MSE to MSE direct replication

Next Steps

- Solicit feedback on mailing list – input is appreciated
- Expand on Control Plane and multi-Multicast SDN Domain section
- Add fault tolerance
- Add use cases
- Call out what can be leveraged from existing protocols and the needed new work

Questions/Discussion

Thanks!