Multiparty Transport Overlay Control Protocol (MTOCP)
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Objective

- Efficient support of group communications
  - Cope with the moderate deployment of IP multicasting in today's Internet.
  - Hide network heterogeneity to the application layer
    - IPv4 and IPv6.
    - Multicast and non-multicast networks.
  - Provide an application-agnostic group data delivery service.
  - Provide a multicast routing-agnostic delivery service.
  - Maximize the use of IP multicast available in the network.

- Solution: Multiparty Transport Overlay Control Protocol (MTOCP)
  - Idea:
    - Place the multiparty overlay paradigm at the transport layer: Multiparty Transport Overlay (MTO).
    - Dynamic addition and removal of MTO's transport connections.
MTO Architecture Components (1/2)

- MTO Tree: a set of overlay nodes (ONs) interconnected through unicast or multicast transport connections.

  - Overlay Node (ON):
    - Forward data based on local forwarding table (packets received on a given "input" transport connection will be forwarded to one or more "output" transport connections).
    - No IP-in-IP tunneling.
    - 3 types but a common functionality: source overlay node (S-ON), on tree overlay node (O-ON), and leaf overlay node (L-ON).

  - Transport Connections of MTO tree
    - UDP.
    - Unicast or Multicast destination address
    - IPv4 or IPv6 addresses.
    - Transport Connection ID: <source address, source port, destination address, destination port>.

Example of an MTO Tree

MTO = Multiparty Transport Overlay
MTO Architecture Components (2/2)

• MTO controller (MTO-Ctrl): control the creation, update, and removal of the MTO tree in the network.
  
  – Define an MTO tree through: an MTO tree ID, a list of ONs and associated transport connections.
  
  – Assign a couple of unique ports (source and destination ports) per MTO tree.
    • Ports SHOULD be used for all transport connections belonging to the same MTO tree.
    • MTO-Ctrl MAY choose to use a different destination port for a given connection of an MTO tree.
      – e.g., the destination port is the listening port of a unicast terminal (MTO-Ctrl MAY learn the destination port through an out-of-band mechanism).
  
  – Push to (and further update for) each ON its MTO Tree-specific forwarding table in the form of a list of input and output transport connections.
  
  – Remove/flush transport connections from ONs.
MTOCP Protocol - Operations

- MTOCP: operates between the MTO-Ctrl and ON to manage the MTO tree.
- Message exchange is initiated by MTO-Ctrl.
- Use of TCP for MTOCP message transport.
- Three types of exchanges
  - Connection Addition
    - Add one or multiple connections of a given MTO tree
  - Connection Removal
    - Remove one or multiple connections of a given MTO tree
  - Connection Flush
    - Remove all the connections of a given MTO tree
MTOCP Protocol – Message Structure

- **Command Message**
  - **CONNECTION_START, CONNECTION_STOP, or CONNECTION_FLUSH**

  - **Command Message Structure**
    - **Command Number**
    - **command_type**
    - **command_length**
    - **MTO_TreeID**
    - **Connection option #1**
    - **Connection option #n**

- **Response Message**
  - **ACK_CONNECTION_START, ACK_CONNECTION_STOP, or ACK_CONNECTION_FLUSH**

  - **Response Message Structure**
    - **Response Number**
    - **response_type**
    - **response_length**
    - **MTO_TreeID**
    - **status**
    - **Connection option #1**
    - **Connection option #m**
Example of MTO Tree Deployment in Today’s Internet

IPv6 (e.g., IPv6 over WiMAX) -> S-ON
unicast IPv4 (e.g., 3G) -> R1
multicast IPv4 (e.g., Ethernet wired LAN) -> R4, R5
multicast IPv6 (e.g., WiFi) -> R2, R3

Internet (unicast IPv4)
MTOCP Implementation Status

- IPv4 support: done.
- IPv6 support: in progress.
- MTOCP implementation integrated in a full context-aware multiparty transport platform (EU FP7 Project C-CAST):
  - MTOCP, and
  - Network context-aware service
    - Network capability detection (multicast, IPv4, IPv6, etc).
    - Dynamic creation and push of ONs and unicast terminal lists to MTO-Ctrl.
  - Leverage of standard protocols
    - SIP protocol for multiparty session initiation (session invitation to terminals).
    - IGMP/MLD for multicast terminals to subscribe to multicast groups.
    - PIM-SM for multicast routing.