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Multicast in a CineGrid testbed

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Research question

‘Investigate the possibility of sending high quality video to multiple destinations using multicast for a reliable, scalable high bandwidth CineGrid testbed without loss of performance’

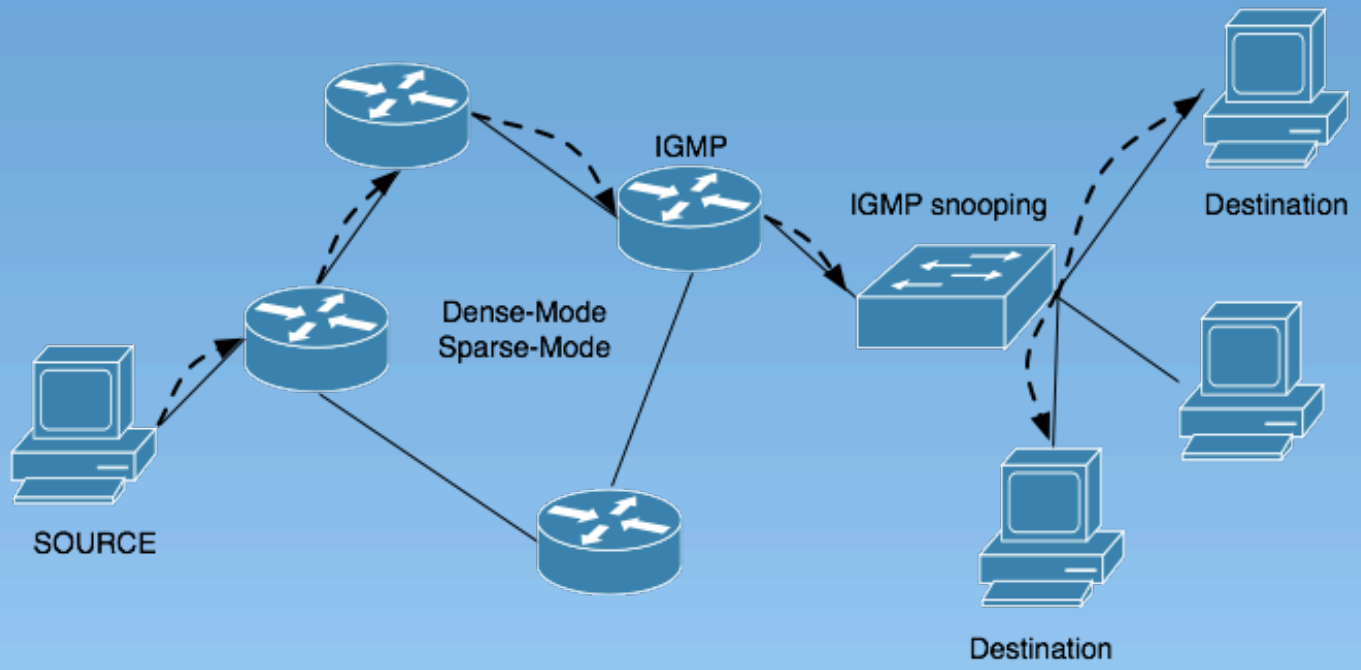
Why multicast?

- For a single 4K (~4 x 1080p) stream: 7,6 Gbit/s is needed
- With unicast: every destination -> factor X more bandwidth
- X = number of receivers
- 7,6 Gbit/s times X = impossible for current hardware of the CineGrid testbed

Research scope

- Traditional multicasting
- Network layer multicasting (NLM)
  - Provider Link State Bridging (PLSB)
- Application layer multicasting (ALM)
  - SAGE bridge

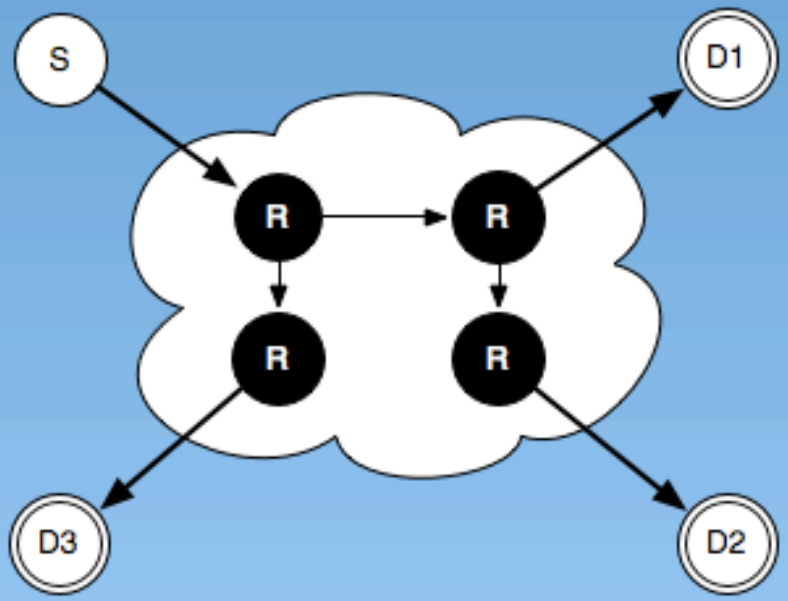
Traditional multicasting



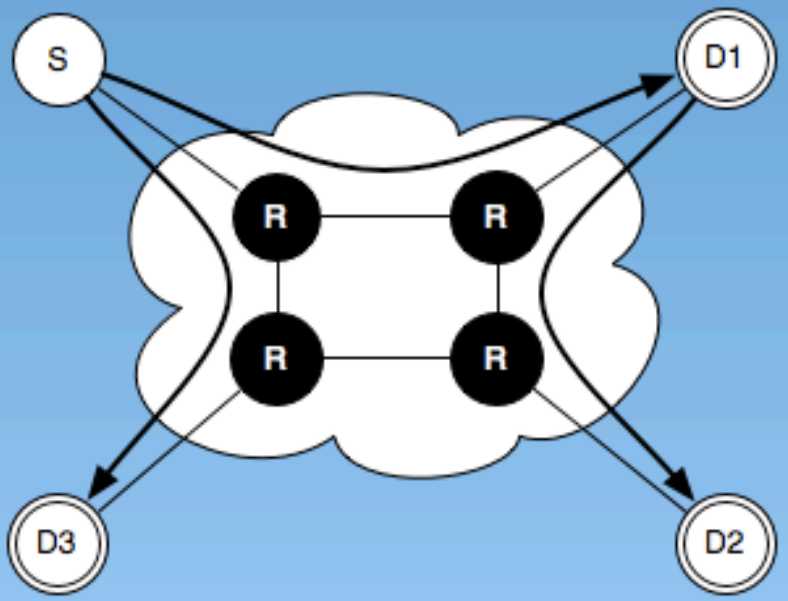
Traditional multicasting

- Multicast addresses: IPv4 (class D), MAC addresses (01-00-5E-00-00-00 to 01-00-5E-FF-FF-FF)
- Internet Group Management Protocol (IGMP): Router sends Host Membership Query, host responds w/ Host Membership Report
- IGMP snooping: switch -> on what port to send the multicast
- Multicast routing protocols (Sparse-Mode, Dense-Mode): SM is pull model, DM is push model

Different multicast solutions



Network layer multicast (NLM)



Application layer multicast (ALM)

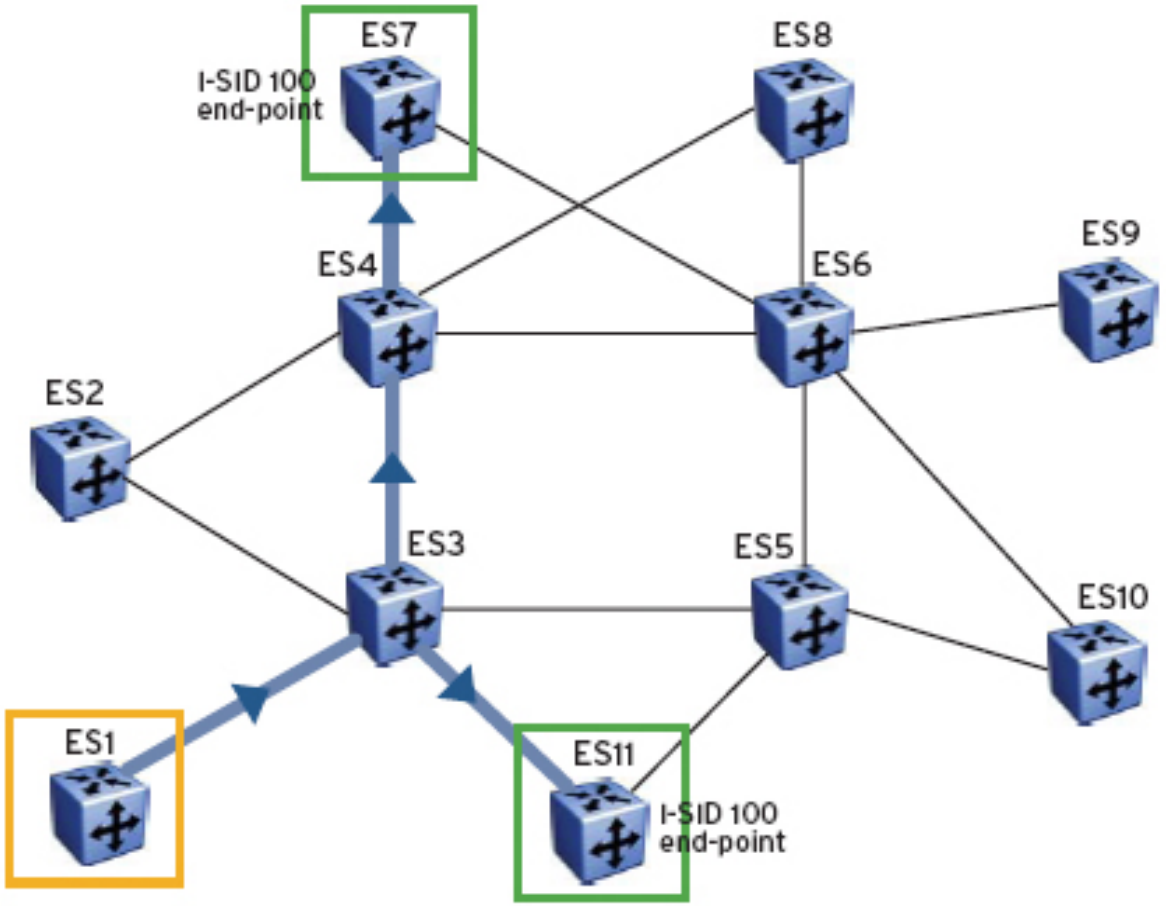
Provider Backbone Transport

- PBT = Provider Backbone Bridges - Traffic Engineering (PBB-TE) and defined in 802.1Qay®
- Build upon Provider Backbone Bridges (MAC-in-MAC)
- No Spanning Tree Protocol (STP) or MAC-learning
- Primary & backup path (not forced): fail-over in <50 ms
- Important for the CineGrid: scalability, reliability & QoS

Provider Link State Bridging

- PLSB = Shortest Path Bridging is defined in 802.1aq®
- Each B-VLAN: flooding & learning -> disabled
- Link state protocol Intermediate System to Intermediate System (IS-IS)
- IS-IS, flexible routing protocol: easily adapted. Remove IP w/ layer 2 functionality (B-MAC addresses & I-SID)
- All nodes inform neighbors (LSA) -> Share view network. PLSB applies Shortest Path First (SPF), Forwarding Information Base (FIB) -> every node

PLSB multicasting

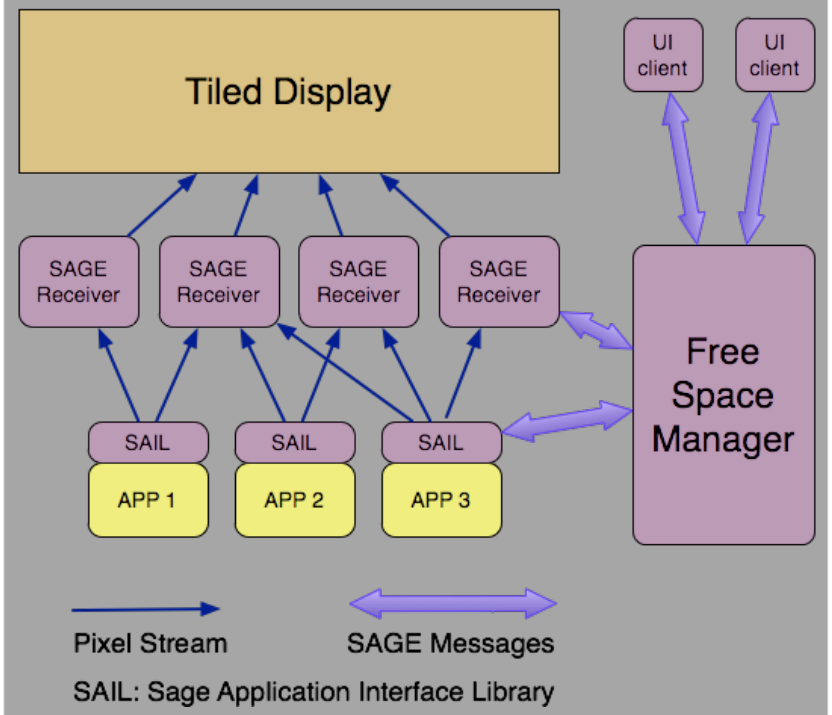


Source: Nortel Networks. *Introduction to Provider Link State Bridging*. 2007

SAGE

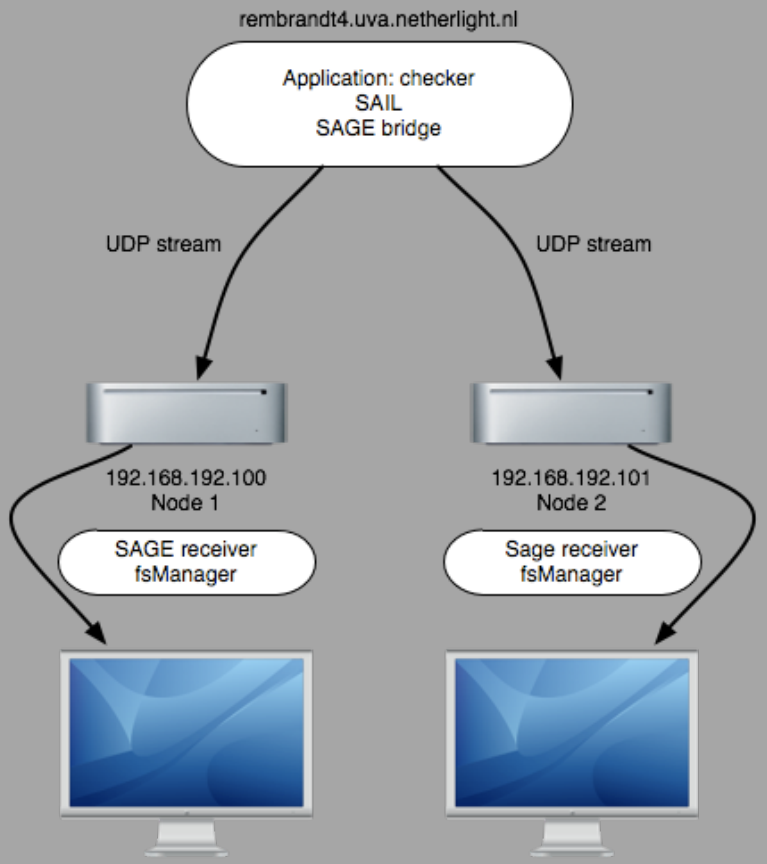
`Scalable Adaptive Graphics Environment (SAGE) is a specialized middleware for streaming high quality video and high resolution graphics in real-time from remote locations to multiple displays over very fast networks'

Source: Byungil Jeong et al. *High performance dynamic graphics streaming for SAGE*. 2006

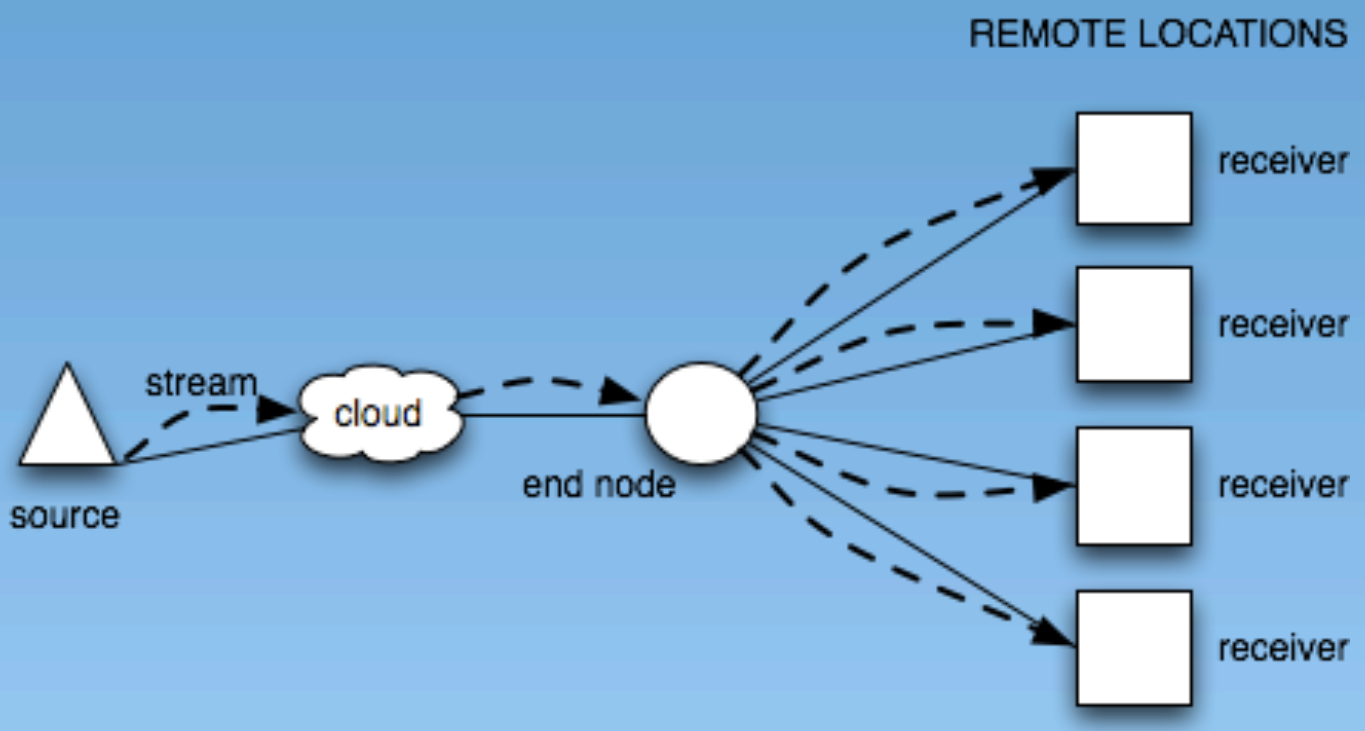


SAGE bridge

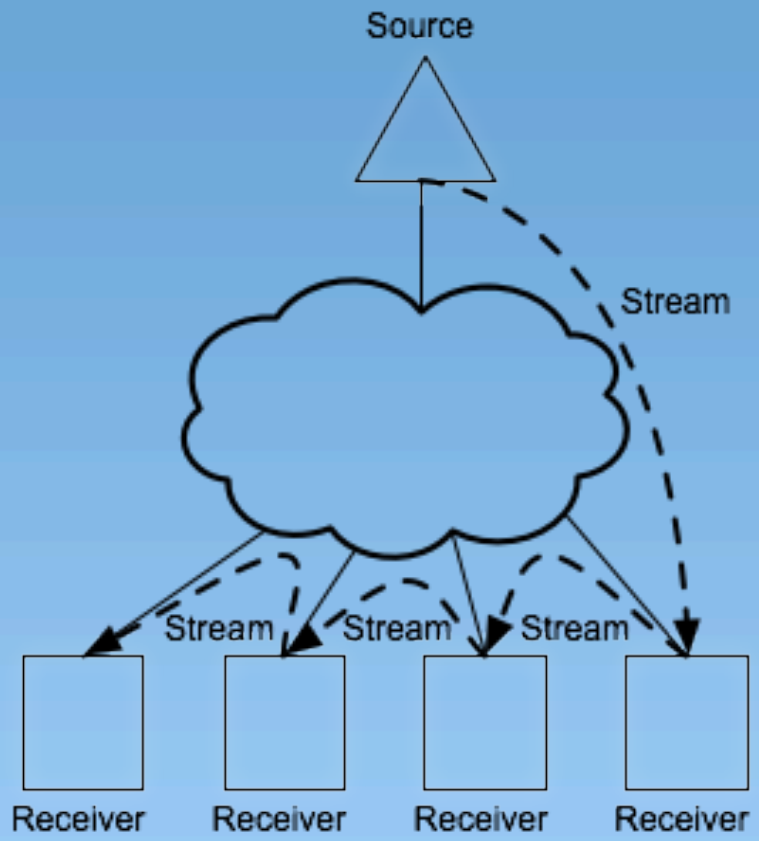
- Test: try to send a stream from a SAGE bridge to multiple destinations
- Installation: SAGE & SAGE bridge on the central node, on display nodes SAGE & fsManager w/ two displays attached
- Results: sending to both the nodes, stream successful initialized, tcpdump captured packets from both the nodes
- Problem: the second screen stays black



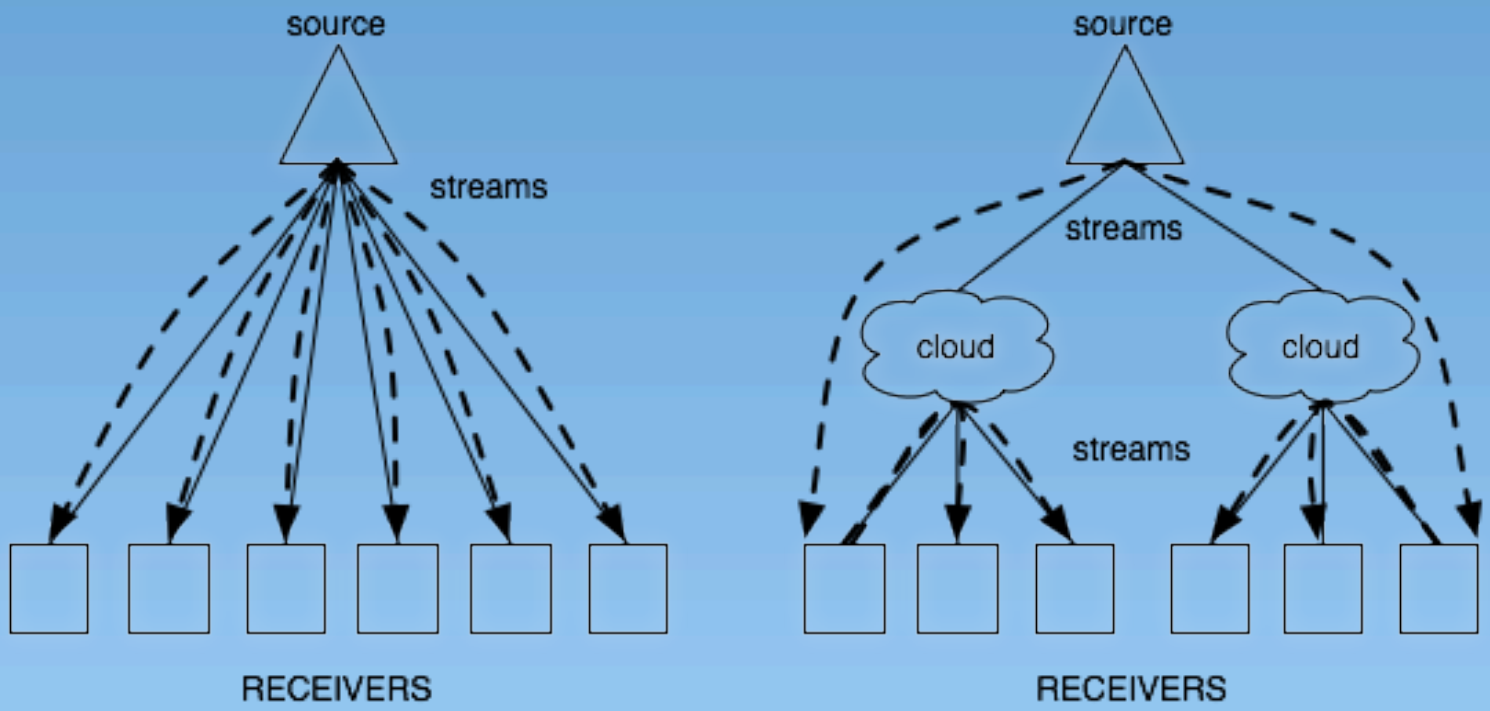
Placing end nodes



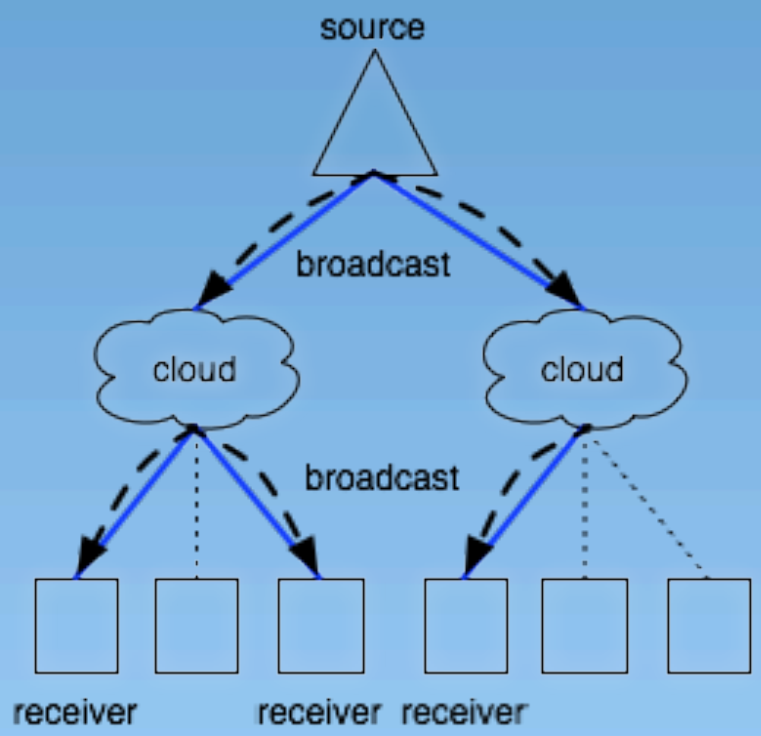
Chain reaction



Create hierarchy



Create VLANs



Conclusion and future work

- SAGE bridge is a possibility for multicasting
- APM is a possibility for multicasting
- PLSB ‘cutting-edge’ and no experience
- Advantages and disadvantages NLM/ALM

- More research on the black screen of the 2nd display
- More investigation on different APM applications
- PLSB should be tested in conjunction with PBT
- Performance test comparing NLM/ALM