

Overlay Hybrid Multicast Platform

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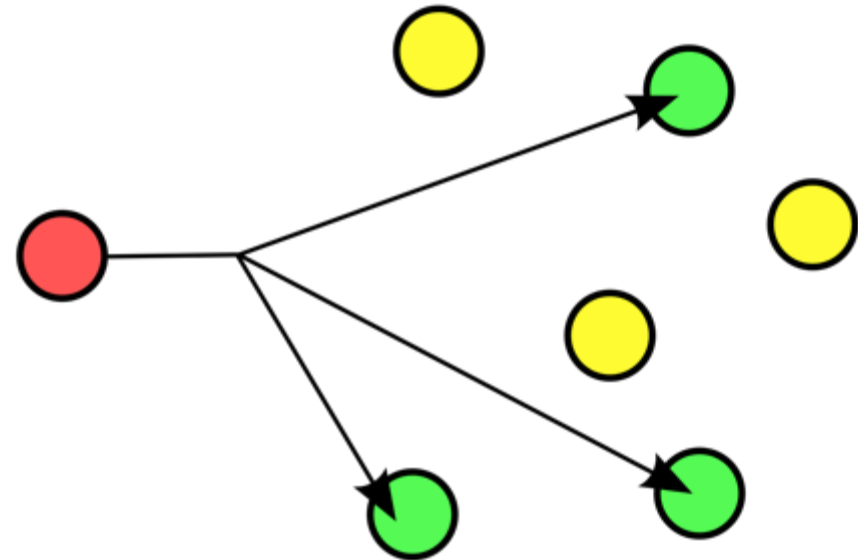
Introduction

Some internet traffic are distributed one-to-many or many-to-many.

Most notably: IPTV and conference calls.

By 2017, 91% of Internet traffic is video [Cisco's Visual Networking Index].

Multicast would hugely reduce bandwidth and management overhead.



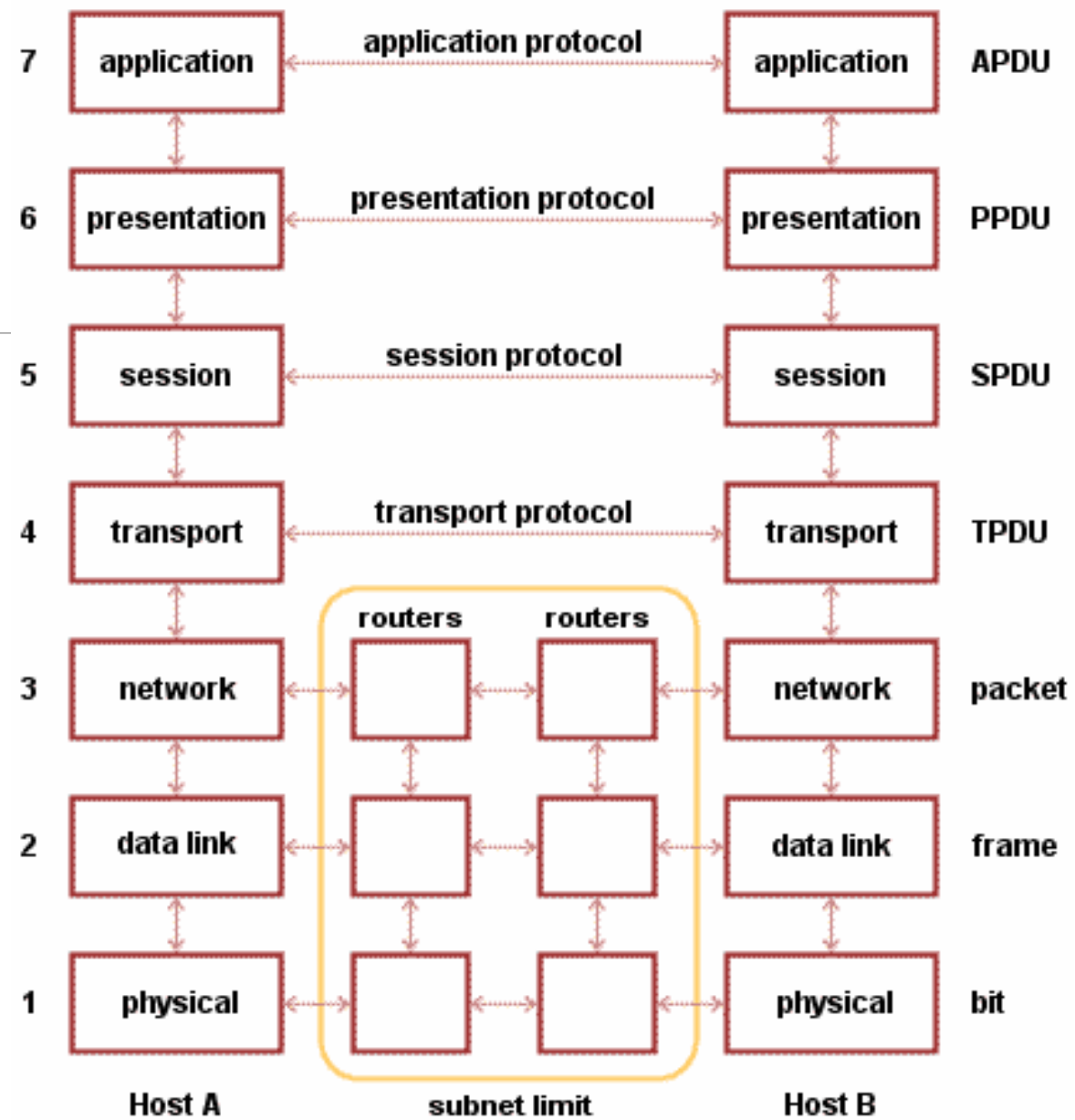
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Introduction –Cont.

Multicast can be offered at:

- The network layer: Native Multicast NM
- Application layer: Application Layer Multicast ALM

IGMP



Introduction –Cont.

Application Layer Multicast

Introduction –Cont.

NATIVE MULTICAST

- Routers forward and replicate multicast messages.
- Require support by the infrastructure.
- Very efficient
- Currently, Native Multicast is not supported globally.
- The created the issue of Multicast Islands.

APPLICATION LAYER MULTICAST

- Hosts and peers forward and replicate multicast messages.
- Require support and participating by hosts.
- Easy to deploy as it does not require infrastructure support.
- Uses Peer to Peer technology to create and maintain the multicast tree.
- Not as efficient as NM.

Introduction –Cont.

Native Multicast requires that the network can support Multicasting universally.

However:

- Not all of routers support Multicast.
- Multiple incompatible native multicast approaches co-exist.

Thus a solution connecting the various Multicast Islands and bridging between different NM techniques is needed.

Hybrid Multicast

Hybrid Multicast uses Application Layer Multicast together with tunneling.

Hybrid Multicast gains the benefits of the two approaches i.e. ALM and NM:

- Greater efficiency of Native Multicast
- Readily availability of ALM

Hybrid Multicast –Cont.

It has not been given sufficient attention by the research community

We aim to address the shortcoming by analysing and evaluating a framework for Hybrid Multicasting using peer-to-peer overlay by integrating Native Multicast (NM), Automatic Multicast Tunnelling (AMT) and Application Layer Multicast (ALM).

Hybrid Multicast –Cont.

The answer is tunneling.

The mechanism in which the solution uses tunneling is very important for the performance.

Two ways to build tunneling:

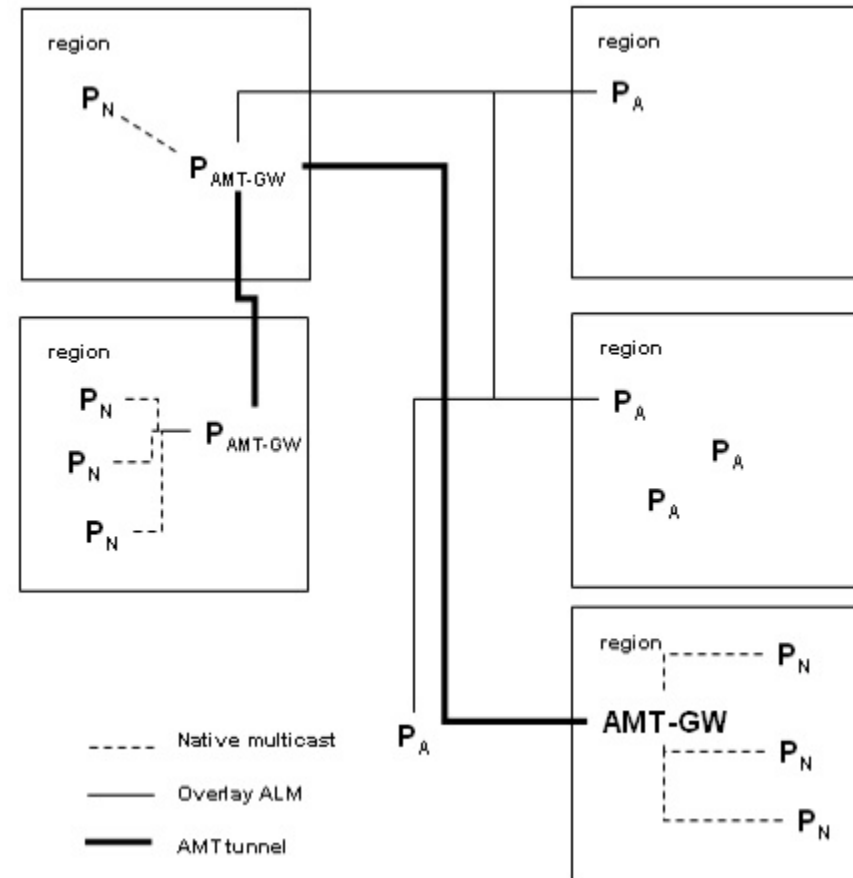
- **Explicit Tunneling:**
 - Tunnels need to be created and managed manually.
 - Hard to scale
 - Layer 4 header is hidden.
 - Example: Multicast over GRE Tunnel
- **Without Explicit Tunneling:**
 - Tunnels are created and maintained automatically.
 - The shape and topology of these tunnels will change dynamically as the underlying network changes.
 - Can utilize Peer to Peer.

Hybrid multicast

Automatic Multicast Tunneling AMT connects different islands with tunnels that are built automatically.

Keep layer 4 header intact.

AMT Gateways and Relays are used to create and manage the tunnels.



Proposed Model

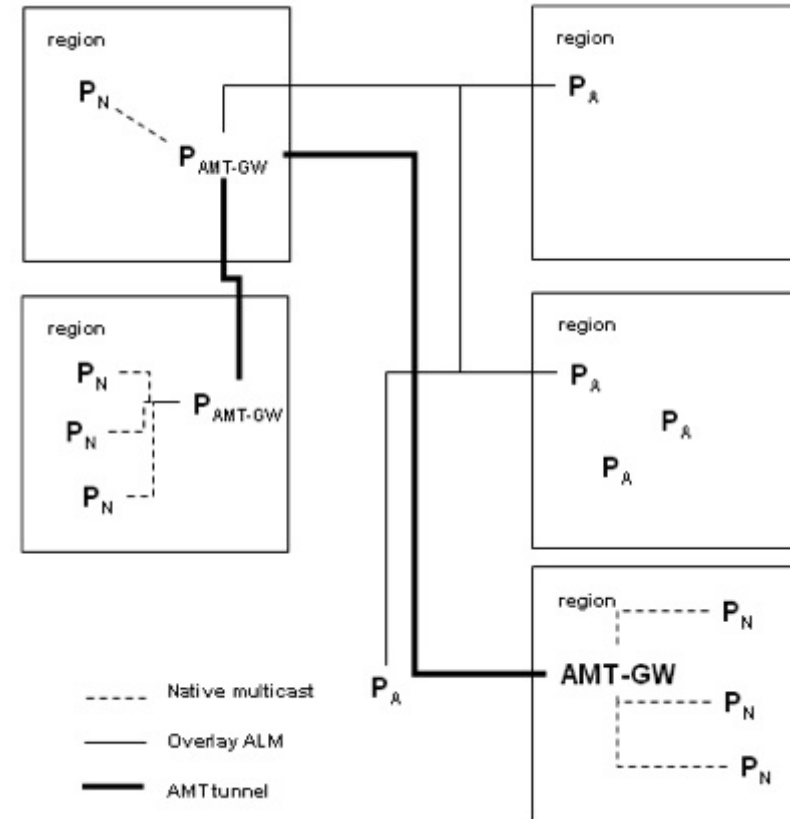
We have proposed a model that combines AMT with Peer to Peer to achieve better

- Efficiency
- availability of multicast communication
- Scalability
- Adaptability.

takes advantage of cross layer awareness

Proposed:

- Islands Discovery
- Nodes Election Mechanisms



Proposed Model –Cont.

AMT can use the ALM infrastructure to propagate data.

- Especially with large number of AMT gateways

Add resiliency to the network.

Simulation Framework

Evaluating hybrid multicast protocols is difficult for two reasons.

- The simulation environment must combine both a scalable overlay and a detailed network layer that includes routers with NM support.
- Suitable metrics are needed to compare the tree quality with pure ALM trees.

Simulation Framework –Cont.

AMT is not implemented in any existing simulator.

Peer to Peer simulators does not do well when considering underlay.

We have used OMNeT++ for the following reasons:

- **Extensible and Modular:**
 - Open source.
 - Modular design.
 - Code reusing.
- **INET model:**
 - provides a wide range of models of several Internet protocols which include IGMP.
- **Oversim:**
 - provides a framework to simulate peer-to-peer overlays protocols.

Simulation Framework –Cont.

This paper presents our approach to simulating and evaluating hybrid multicast protocols.

We present a simulation framework which includes a model of the underlay network integrated with a model of the overlay.

For the underlay, we have implemented an AMT module which tunnels multicast traffic islands.

The first simulation work to incorporate the AMT architecture into a hybrid multicast framework.

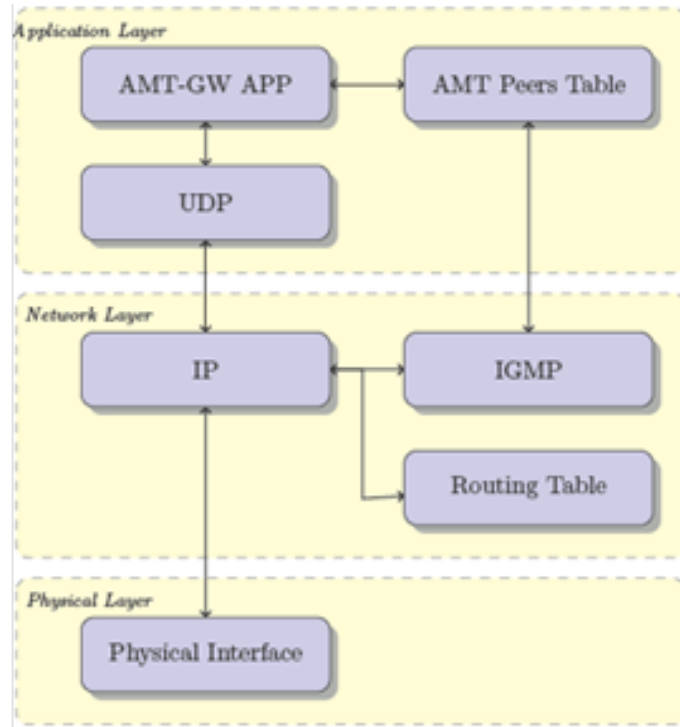
For the experimentation in this paper we use the Scribe algorithm.

Thus our framework is different to most overlay simulations in that it combines an overlay with a packet level model supporting multicast and tunnelling.

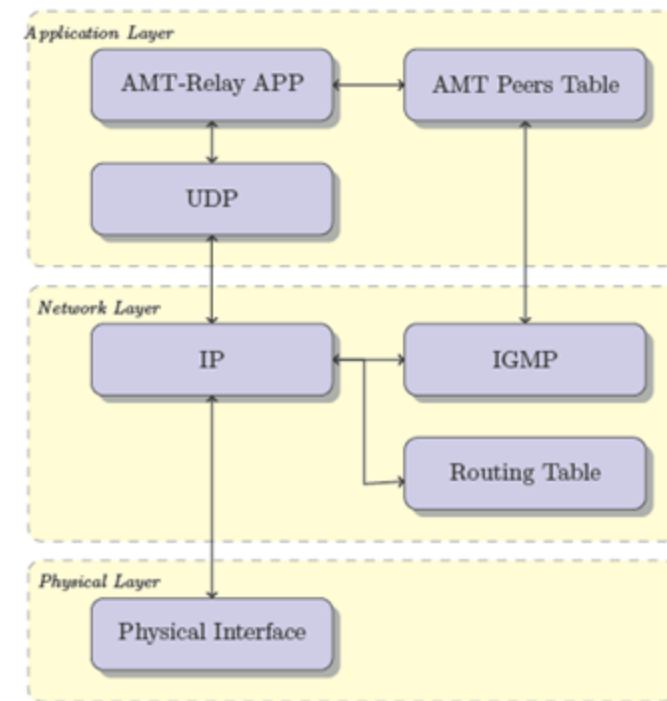
We present simulation results comparing message load for an AMT backbone with an ALM backbone in hybrid multicast demonstrating the suitability of our hybrid multicast approach.

Simulation Framework –Cont.

AMT GATEWAY



AMT RELAY



Results

We simulated the following network:

- 2000 node
- A source node sends multicast traffic at 1 packet every 5 seconds.
- Islands ranging from 25 up to 150 islands.

We rerun the simulation for the following configuration:

- **ALM only:** There is no native multicast support anywhere in the network.
- **Native Multicast only:** Every router support NM.
- **Hybrid overlay:** In this configuration, the AMT devices use Scribe to discover each other and forward multicast traffic between islands. We call this configuration: Opportunistic Native Multicast **ONM**

Metrics

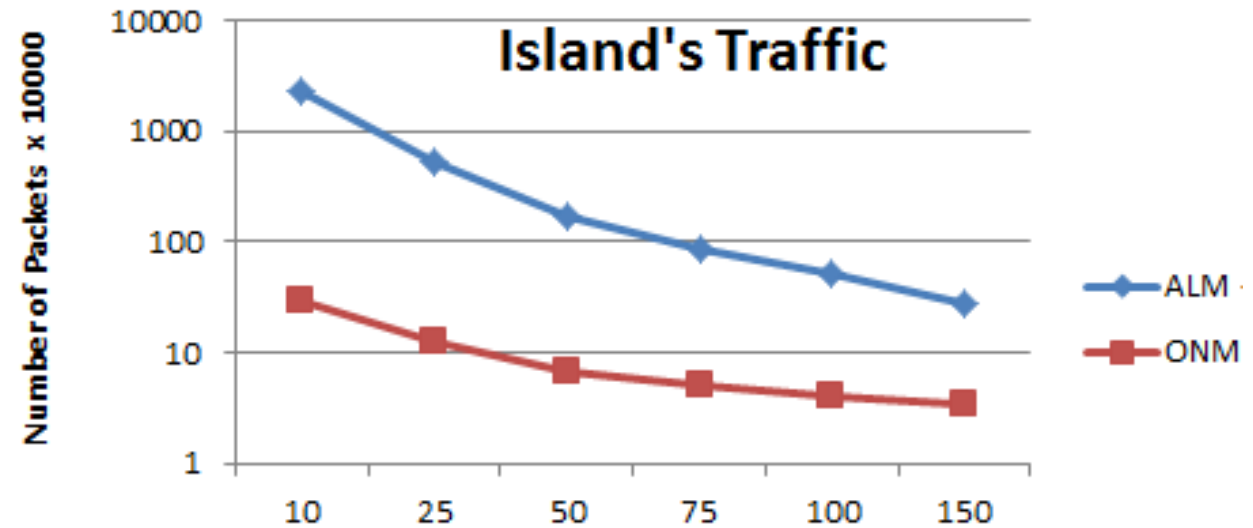
- **The Stretch:** is the delay of the overlay path over the delay of a unicast message.
- **The Stress:** is the number of identical copies of a message carried by a link or a node
- **Delivery Rate:** is the percentage of the message received over the number of message that the node should receive

Results –Cont.

the number of packet routed inside every island.

as more islands exist in the network, the average of nodes per islands decreases.

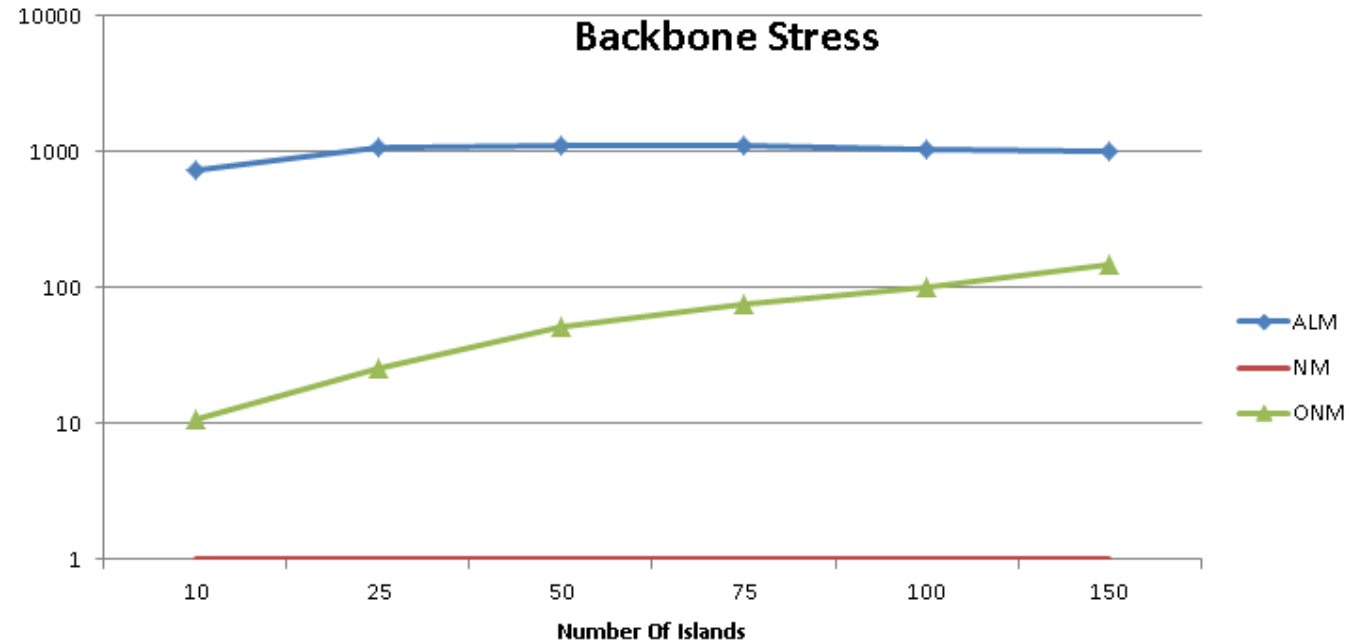
ONM produce less traffic inside the island compared with ALM.



Results –Cont.

ALM Stress on the backbone is exponentially greater than ONM's.

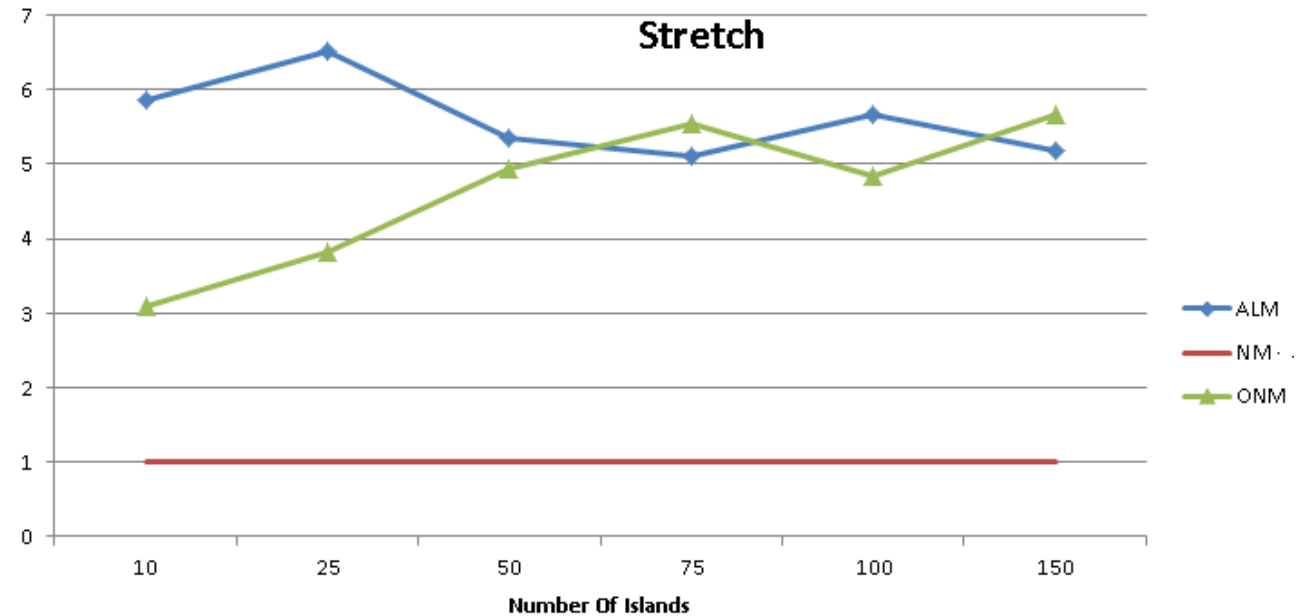
ONM results in much lower Stress on the backbone. There is a linear relation between stress and the number of islands.



Results –Cont.

With small number of islands, we can see that ONM results in a better Stretch in the overlay.

However, we can see that the stretch has little dependence on the number of islands in the case of pure ALM.

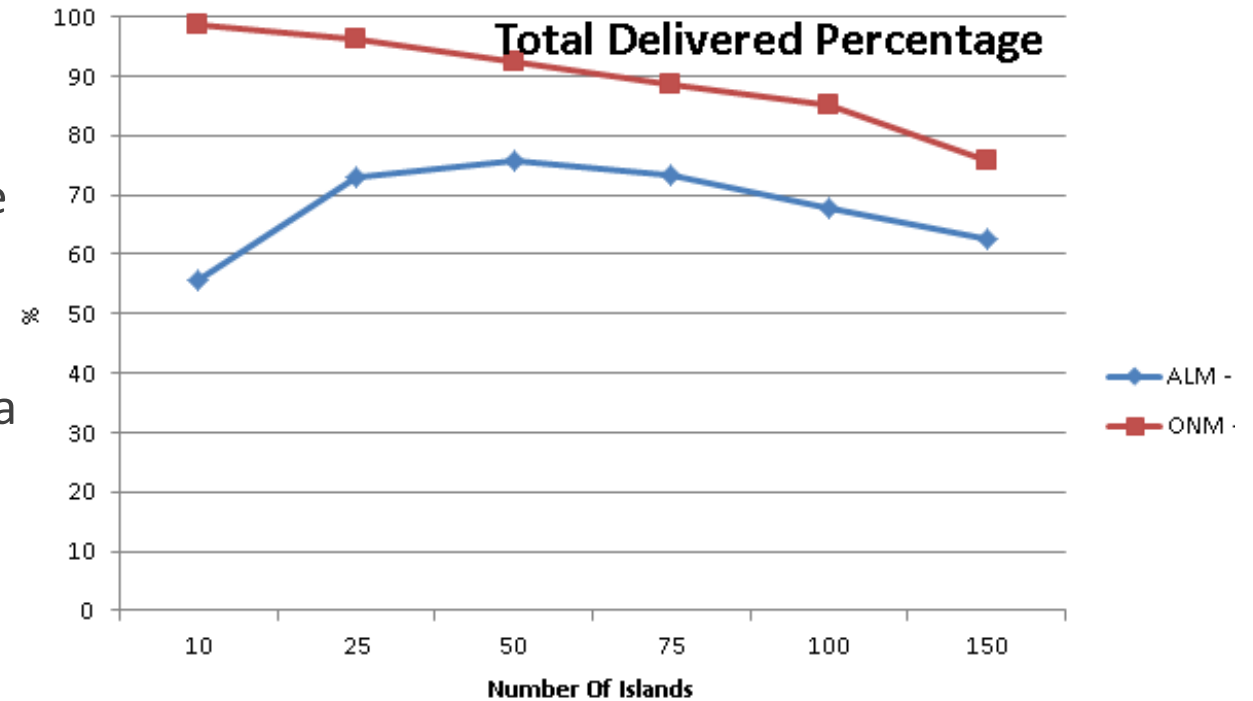


Results –Cont.

Shows the effect of the increase of the number of islands on the delivery rate.

We can see that more islands decrease the rate of delivery of the network.

This is due to, in the case of ALM, the time that it would take for nodes in different islands to build the tree.



Future Work

Source effect

- ONM effect on the source of the tree.

More Native Multicast Protocol

- Xcast
- Other MDR

Conclusion

We have presented a simulation framework to simulate hybrid multicast.

We have implemented AMT relay and gateway components in the simulator.

In this model, native multicast is used opportunistically wherever possible.

We have presented results, analyzing different metrics which demonstrate the validity of hybrid multicast.