End System Multicast (ESM) allows for live audio and video content to be delivered over the Internet at a low cost to the broadcaster. It achieves this by harnessing the idle network resources of its viewers to help distribute the broadcast. The viewers automatically arrange themselves into a broadcast distribution tree. The tree continuously adapts to network dynamics, attempting to obtain the highest bandwidth and lowest latency.

### Overview of ESM

**Figure 1.** End systems (viewers) self-organize into a high performance data distribution tree structure.

### Key Benefits of ESM

- No extra router support necessary
  - In contrast to IP multicast solutions
- No infrastructure servers necessary
  - In contrast to content delivery services
- Instantly deployable by end users
- No central performance bottleneck
  - Load shared across end systems
- Extremely cost-effective
- Better routing from broadcaster to viewer
- Adaptive to heterogeneity and dynamics in end system and Internet performance

### Value-Added Features

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Priority</th>
<th>Bandwidth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audio</td>
<td>High</td>
<td>15Kbps</td>
</tr>
<tr>
<td>LQ Video</td>
<td>Low</td>
<td>100Kbps</td>
</tr>
<tr>
<td>HQ Video</td>
<td>Low</td>
<td>300Kbps</td>
</tr>
</tbody>
</table>

**Figure 2.** High priority audio and LQ video are selectively sent to bandwidth constrained San Jose wireless viewer

- Prioritized audio and video transmission
  - Ensures high fidelity audio and clear video even when network congestion occurs
- Network-friendly TCP-based congestion control

### Applications

- Pittsburgh broadcast
- Berkeley viewer
- San Jose wireless viewer
- Boston viewer

- 415Kbps
- 115Kbps