MI Streamnet Project Case Study

• Project objectives
  – Provide infrastructure for statewide live webcasting
  – Provide infrastructure for video on demand
  – Minimize bandwidth impact on Internet connections

• Project stakeholders
  – Regional Education Media Center (REMC)
  – Participating Michigan RESA’s/ISD’s
  – Merit Network, Inc.
  – Apple
MI Streamnet History

MichNet
Wayne RESA
member/affiliate network
ISD network connection via 3rd party ISP

Choke point

QTSS Broadcaster & Streaming server

member/affiliate network

member/affiliate network

member/affiliate network

member/affiliate network

member/affiliate network
Users will receive the stream from a local relay server.

Re-distribution of stream from master server to secondary servers.

Network connections:
- Multicast or Unicast streams
- 200-300Kbps

Connection via 3rd party ISP:
- Users will receive the stream from a local relay server within a campus.
MI Streamnet Nodes

Statewide streaming for education in Michigan
MI Streamnet Architecture

• Broadcasts can be initiated from any Internet node
• Parent Node at Merit Data Center (Ann Arbor, MI)
  – “Push” relays to participating RESAs and ISDs
  – Content replication via rsync
  – Apache CGI redirection script
• Child nodes in RESAs/ISDs across the state
  – Establish .sdp files to relayed streams from Parent Node
  – Replicated content from Parent Node
  – Locally hosted video on demand content
• Catch all Server “Shunt”
  – Up to 50 non REMC users
Webcasting Implementation

Unannounced destinations

• Announce Live Stream from encoder
  – QuickTime Broadcaster “Automatic Unicast”
• Announced .sdp file is the Relay Source on the Parent node
• Each Child Node destination configured as Unannounced UDP
  – Copy the sdp file created by Broadcaster
  – Edit the file to match relay destination settings
  – Distribute the file to all Child Nodes
Unannounced Relay
MI Streamnet Relays

What we learned

• Unannounced relays require more setup
  – Editing and distribution of sdp file
  – The same sdp file can be used on all Child Nodes

• Unannounced relays are more robust
  – If connectivity with a Child Node is lost, the parent continues to relay to all destinations
  – When a connectivity to a child node is restored, clients will automatically reconnect
### MI Streamnet Parent Relay

**List of relays**

<table>
<thead>
<tr>
<th>Enabled</th>
<th>Relay Name</th>
<th>Destination Address</th>
<th>Destination Type</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Channel20UDP</td>
<td>mistreamnet2</td>
<td>Unannounced UDP</td>
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<tr>
<td></td>
<td>Channel02UDP</td>
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</tr>
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<td>Channel03UDP</td>
<td>coppercountryisd</td>
<td>Unannounced UDP</td>
</tr>
<tr>
<td></td>
<td>Channel04UDP</td>
<td>wexford-missaukeeisd</td>
<td>Unannounced UDP</td>
</tr>
<tr>
<td></td>
<td>Channel05UDP</td>
<td>muskegonisd</td>
<td>Unannounced UDP</td>
</tr>
<tr>
<td></td>
<td>Channel06UDP</td>
<td>grattot-isabellaresd</td>
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<tr>
<td></td>
<td>Channel07UDP</td>
<td>bay-arenacisd</td>
<td>Unannounced UDP</td>
</tr>
<tr>
<td></td>
<td>Channel08UDP</td>
<td>ottawaisd</td>
<td>Unannounced UDP</td>
</tr>
<tr>
<td></td>
<td>Channel09UDP</td>
<td>vanburenisd</td>
<td>Unannounced UDP</td>
</tr>
<tr>
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<td>Unannounced UDP</td>
</tr>
<tr>
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<td>Channel11UDP</td>
<td>genesesisd</td>
<td>Unannounced UDP</td>
</tr>
<tr>
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<td>Channel12UDP</td>
<td>jacksonisd</td>
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</tr>
<tr>
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<tr>
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</tr>
<tr>
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<td>Channel16UDP</td>
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</tr>
<tr>
<td></td>
<td>Channel17UDP</td>
<td>noxqt1.harvard.edu</td>
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MI Streamnet Parent Relay

“Channel 20” Source
MI Streamnet Parent Relay

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MI Streamnet Parent Relay

“Channel 20” Destination
v=0
o=ctnadmin 3289090834 3289090834 IN IP4 205.39.0.242
s=/020.sdp
i=IN IP4 127.0.0.1
r=0 0
a=control:*
m=audio 21326 RTP/AVP 96
a=rtpmap:96 x-Purevoice/11025/1
a=control:trackID=1
m=video 21328 RTP/AVP 97
a=rtpmap:97 X-QT
a=cliprect:0,0,240,320
a=control:trackID=2
MI Streamnet Live Redirection

Redirecting clients to Child Nodes

- To reduce bandwidth consumption, clients must connect to the correct server
- QuickTime can open URLs to CGI Scripts
- References to QuickTime Streams can be expressed in text (.qtl files, .smil files, RTSPtext files, etc.)
- MIStreamNet uses a Perl CGI for redirection
  - Based on the client’s IP address
  - Returns .qtl text to redirect client to the appropriate Child Node
  - Logs connections
  - Works with .sdp, .mp4, and .mov files
## Redirection Configuration File

<table>
<thead>
<tr>
<th>Child Node IP Address</th>
<th>Client IP Address Range Start</th>
<th>Client IP Address Range End</th>
<th>Multicast on this Child Node?</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>205.38.89.160</td>
<td>205.38.64.*</td>
<td>205.38.95.*</td>
<td>undef</td>
<td>(REMC 14) Genessee ISD</td>
</tr>
</tbody>
</table>
Calling the Redirection Script

Script returns .qtl text (XML):

```xml
<xml version="1.0">
<quicktime type="application/x-quicktime-media-link">
<embed src="rtsp://205.108.89.171/020udp.sdp" controller="true" autoplay="true" quitwhendone="false"/>
</quicktime>
</xml>
```

Embedded in the MIStreamNet page:

```xml
<object classid="clsid:02BF25D5-8C17-4B23-BC80-D3488ABDDC6B"
    codebase="http://www.apple.com/qtactivex/qtplugin.cab#version=6.0,2,0"
    width="215" height="175" align="middle">
    <param name="src" value="click4player.jpg"/>
    <param name="type" value="video/quicktime"/>
    <param name="cache" value="false"/>
    <param name="target" value="QuickTimePlayer"/>
    <param name="href" value="http://mistreamnet1:8080/cgi-bin/mistreamnet.pl?020udp.sdp"/>
    <param name="autoplay" value="true"/>
    <embed align="middle" width="215" height="175"
        src="click4player.jpg"
        type="video/quicktime"
        cache="false"
        target="QuickTimePlayer"
        href="http://mistreamnet1:8080/cgi-bin/mistreamnet.pl?020udp.sdp"
        autoplay="true"/>
</object>
```
Testing and Configuration of MI Streamnet

• Load testing the Parent Server
  – Use StreamingLoadTool to stress test the Parent Node
  – Use a Python script to stress test the redirection script
    – Requests the redirection URL and prints success or failure
  – Testing helped isolate and resolve specific problems
    – Use StreamingLoadTool to stress test the Parent Node

• Configuring MI Streamnet Servers
  – All unnecessary services disabled
  – File copies over secure connections
  – Firewall rules limit access
StreamingLoadTool

MI Streamnet test

• /usr/bin/StreamingLoadTool binary
  – Can be copied to any Mac OS X system
• streamingloadtool.mov must be in the server’s Movies directory
• streamingloadtool.conf modified:
  – Runforever yes
  – concurrentclients 50
  – url rtsp://mistreamnet1/020udp.sdp
• Ran multiple instances of StreamingLoadTool on 3 systems while monitoring the stream with QT Player and tailing the StreamingLoadTool log file
MI Streamnet Content Replication

Using rsync for content distribution

- rsync command-line utility is built into Mac OS X
  ```bash
  rsync -R --verbose --stats --recursive --rsh=/usr/bin/ssh /Library/QuickTimeStreaming/Movies/sync/ admin@mistreamnet2: />
  ```
- Used to synchronize content from “Movies” directory across MI Streamnet nodes
- Synchronization occurs at specified times via the system crontab on the Parent node
- Uses ssh for secure connections
- Replicated content works with redirection script
MI Streamnet Monitoring

For local administrators

• Web CGIs use the QTSS Admin Protocol
• Report server status, current bandwidth and connected users
• Procedure for publishing locally produced content
  – QTSS Publisher
• Moodle web site to provide ongoing training and communication to local admins
QTSS Publisher

Easy to use content management and publishing

• “Child nodes” on MI Streamnet need to publish School and District specific content
• Technology coordinators need an easy graphical tool for managing local content and publishing web pages
• Need to provide access without compromising security of servers