Application areas of Scalable Adaptive Multicast

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What is SAM?

- **Issues**
  - **Large Number of Groups**
  - **Group Membership Management**
    - member = 3 ~ Huge
  - **Network Topology**
    - Mesh / Tree / DHT
  - **Network Resource Constraints**
    - Bandwidth, Latency, Error rate
  - **Higher Level Requirements**
    - Congestion Control, Reliability, Security
Applications Areas

Application is KEY for deployment

- Kind of Networks
  - Adhoc Networks
  - Sensor Networks
  - Home Networks
  - Office/Building Networks

- Kind of Content
  - Video / Audio
  - Information Sharing (Whiteboard / Display)
  - Sensing data
### Who will be communicating?

Communication based grouping of Application Areas

<table>
<thead>
<tr>
<th>Source</th>
<th>Human</th>
<th>Machine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Destination</td>
<td>Voice/Video Conferencing, Streaming</td>
<td>Home Networks</td>
</tr>
<tr>
<td>Human</td>
<td>Skype, Kontiki, Sharecast ...</td>
<td>Sensor Systems</td>
</tr>
<tr>
<td>Machine</td>
<td>Building Systems</td>
<td>?</td>
</tr>
</tbody>
</table>
Current Applications

- Skype
  - P2P Audio/Video Conferencing
  - SkypeCast
    - Audio Conferencing for 100 people

- p2pradio
  - P2P radio streaming
  - http://www.streamerp2p.com/
Video Streaming Systems

- Kontiki ([http://www.kontiki.com](http://www.kontiki.com))
ShareCast

- P2P Video Streaming Service
  - [http://www.scast.tv](http://www.scast.tv) (Japanese)
XCAST

- eXplicit multi-Unicast
- VIC and RAT is currently used.
- Video: [http://www.cogma.org/press/video/xcast_e_1000k.wmv](http://www.cogma.org/press/video/xcast_e_1000k.wmv)

In reality more than 30 peoples can join the same group.
Tour de France E-bicycle Demonstration

- Tour de France:
  - July 1st, Strasbourg ~ July 23rd, Paris

- Communication between Bicycles & Crew & Supporter

- XCAST6 is used for audio/video communication among the rider/crews.

- XCAST6 is working with NEMO (Network Mobility)
E-Bicycle with NEMO

The E-Bicycle

- Mobile Router (MR)
- Power-over-Ethernet hub
- Local Fixed Node (LFN) SONY VAIO U50
- LFN IPv6 Sensor
The Demonstration Scenario
Future Application Areas
Adhoc Networks

- Multicast in the Ad-hoc Environment
  - Several researches...
  - Apparently SAM is required in Adhoc but not yet solved.

- Multi-layered multicast
  - Multicast over AODV (MAODV)
Adhoc Emergency Networks

- In the disaster situation (Earthquake) there is no Infrastructure.
- Adhoc network can be a solution for this.
- People want to communicate for Information sharing...
Military Adhoc Networks

- Several tanks/troops move together.
- Multi-hop communication is required for low-power RF communication.
Sensor Networks

- Distributed sensors with wired/wireless networks.
- Currently usual adhoc-routing is applied to sensor networks.
- Several sensors should communicate each other.
- SAM can be used in this area.
Ubiquitous Computing

- MIT House_n project
  - http://architecture.mit.edu/house_n/
  - Sensor networks for Home environment
How about current Research?

- A lot of studies / proposals have been done. But not yet stabilized.

- How can we “Research and Develop” and finally “Deploy” the fruit of Scalable Adaptive Multicast Systems?
## Taxonomy of SAM related studies

Under Construction…

<table>
<thead>
<tr>
<th>Type of Network</th>
<th>$	ext{ネットワークタイプ}$</th>
<th>Number of Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALMI</td>
<td>Mesh</td>
<td>Yes</td>
</tr>
<tr>
<td>XCAST</td>
<td>Tree</td>
<td>No</td>
</tr>
<tr>
<td>Narada</td>
<td>Mesh</td>
<td>No</td>
</tr>
<tr>
<td>RelayCast</td>
<td>Tree</td>
<td>No</td>
</tr>
<tr>
<td>Peercast</td>
<td>Tree</td>
<td>No</td>
</tr>
<tr>
<td>Scribe</td>
<td>$	ext{スクリプト}$</td>
<td>No</td>
</tr>
<tr>
<td>Bayeux</td>
<td>$	ext{ベーユー}$</td>
<td>No</td>
</tr>
<tr>
<td>CAN-mcast</td>
<td>$	ext{カソーマスキャスト}$</td>
<td>No</td>
</tr>
<tr>
<td>Overcast</td>
<td>Mesh</td>
<td>No</td>
</tr>
<tr>
<td>Scattercast</td>
<td>Mesh</td>
<td>No</td>
</tr>
<tr>
<td>OMNI</td>
<td>$	ext{オーエニ}$</td>
<td>No</td>
</tr>
</tbody>
</table>
Proposal: Standardization of Application Program Interface for SAM

- Too many algorithm/protocols for creating standard.
- For the real world deployment, rich, and high-quality application is truly required.
- But it should not depend on the specific protocol.

Define the API for SAM applications
Example Levels of API

- **Routing Level**
  - Scribe (Pastry based P2P mcast)
    - create(credentials, groupId)
    - join(credentials, groupId, messageHandler)
    - leave(credentials, groupId)
    - multicast(credentials, groupId, message)

- **Application Level**
  - RalayCast
    - Using Proxy based API (Using kind of port forwarding)
    - Not requiring changes for Applications
Several Studies for API and Middleware for SAM


Simulators/Tools for SAM(p2p)

- p2psim
  - Supports Chord, Accordion, Koorde, Kelips, Tapestry, and Kademlia.
  - http://pdos.csail.mit.edu/p2psim/

- MACE
  - A domain-specific C++ like language to describe a distributed system's.
  - http://mace.ucsd.edu/

- Overlay Weaver
  - Java based imp. of Chord, Tapestry, Kademlia
  - Visualizer of P2P network
  - http://overlayweaver.sourceforge.net/
Overlay Weaver (Shudo et al.)

- DHT shell
- Content sharing
- Distributed file system
- Grid info service

- Mcast shell
- Application-level IP Multicast router
- Content distribution

- Routing service interface
- Corresponding to KBR API

- Directory service interface
- Messaging service interface

- Routing runtime interface
- Routing algorithm interface

- Network

- Other services

- Higher-level services

- Applications

- OS/Hardware
- Storage
- Network

- http://overlayweaver.sourceforge.net/
Simple API and Messaging Visualizer of Overlay Weaver

Sample of API

```java
McastConfiguration config = McastFactory.getDefaultConfiguration();
Mcast mcast = McastFactory.getMcast(config);
mcast.joinOverlay(String hostAndPort);
mcast.joinGroup(ID groupID);
mcast.multicast(ID groupID, Serializable content);
```
Summary

- SAM has a lot of Application Areas

- API Standardization is one of the KEY
  - Several examples. (Routing, Application level)

- There are several tools we can use.
  - p2psim, MACE, Overlay Weaver

- Sharing Information is Important
  - Too many researches are working...
  - Building a taxonomy is a good work for RG.