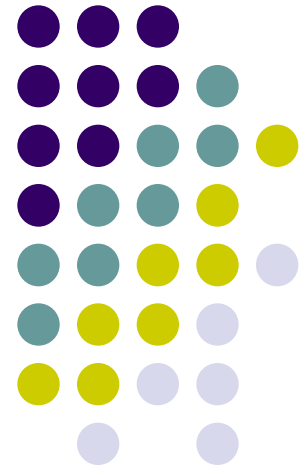


IPTV Experiments and Lessons Learned

Panelist: Klara Nahrstedt

Panel: Large Scale Peer-to-Peer Streaming
& IPTV Technologies



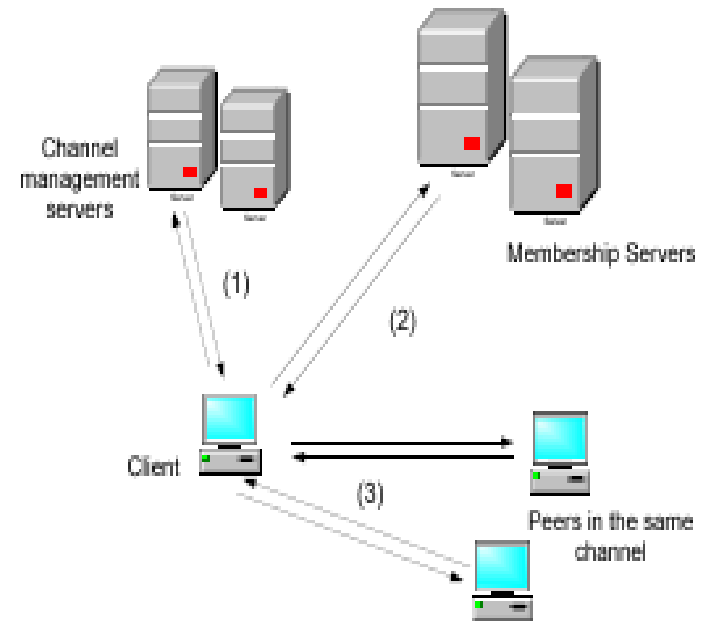
PPLive IPTV System

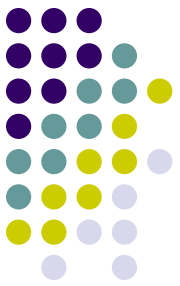


- Well-known IPTV system
 - 3.5 M subscribers in 2005
 - 36.9 M subscribers in 2009 predicted
 - May 2006 – over 200 distinct online channels
 - Revenues could up to \$10 B
 - Need to understand current system to design better future systems

- PPLive Architecture

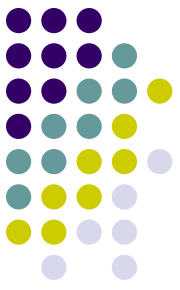
- Management Server
 - Retrieve list of channels via HTTP
- Membership Server
 - Retrieve small list of members nodes of interest via UDP
- Other Peers
 - Learn about other partner peers by periodically probing via UDP





PPLive IPTV Measurements

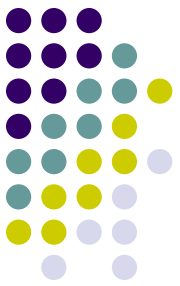
- In 2006/2007 – multiple commercial P2P live systems evaluations/measurements were conducted
 - [1] A. Ali et al in Workshop in Recent Advances in P2P Streaming 2006
 - [2] X. Hei et al in WWW'06 workshop on IPTV Services
 - [3] L. Vu et al in QShine 2007
- Measurements of network-centric metrics
 - Video traffic, TCP connections
- Measurements of user-centric metrics
 - Geographic distributions, user arrival and departure, user-perceived quality
- Measurements of overlay-based characteristics
 - Size of overlays, average degree of a peer, availability relation between peers, user behavior, session length, channel population size



Methodology of Study in [3]

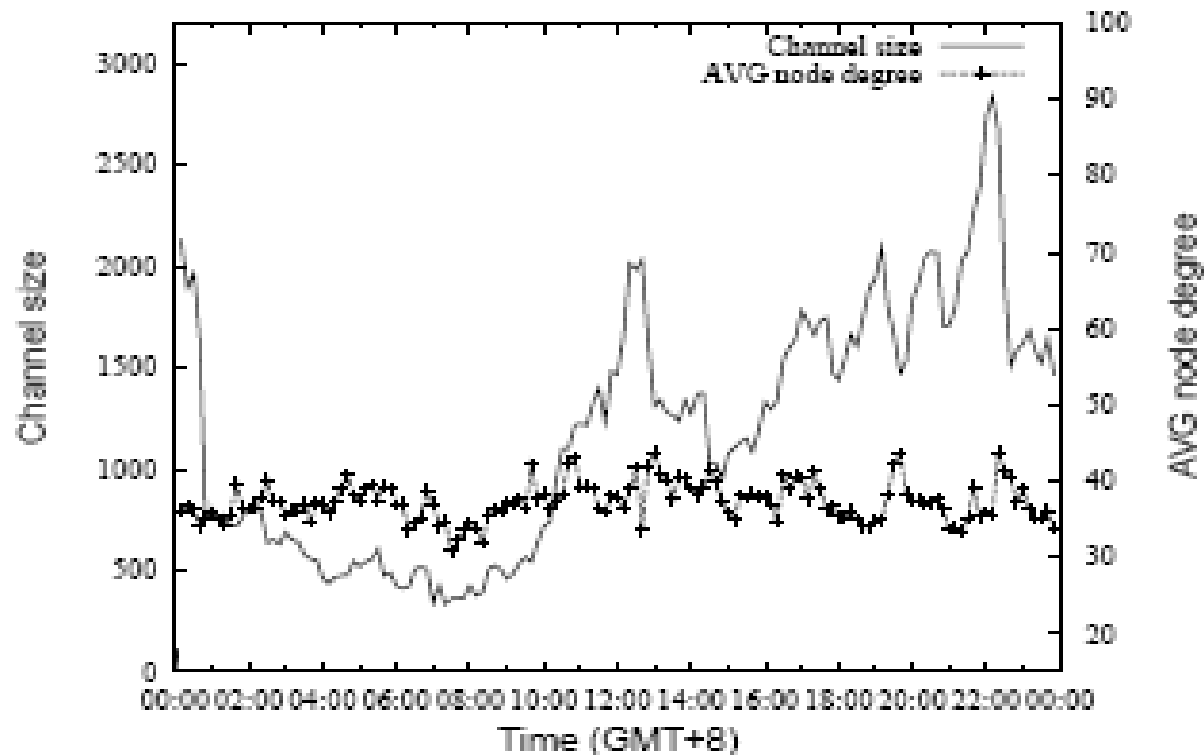
- Crawler-based measurement study
- UIUC machines or Planetlab machines join PPLive channel and then crawl peers that joined the channel
- Crawler collects information and we get snapshot

	Chan. size	PS Len	#Pro	Pro Len	Type
A	32K-45K	6h15m	6	36m-2h	Movie
B	10K-15K	4d4h	300	20m	Cartoon
C	8K-12K	1d2h16m	40	40m	Movie

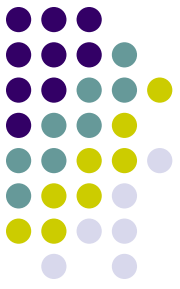


Findings

- Average Node degree is independent of channel population size

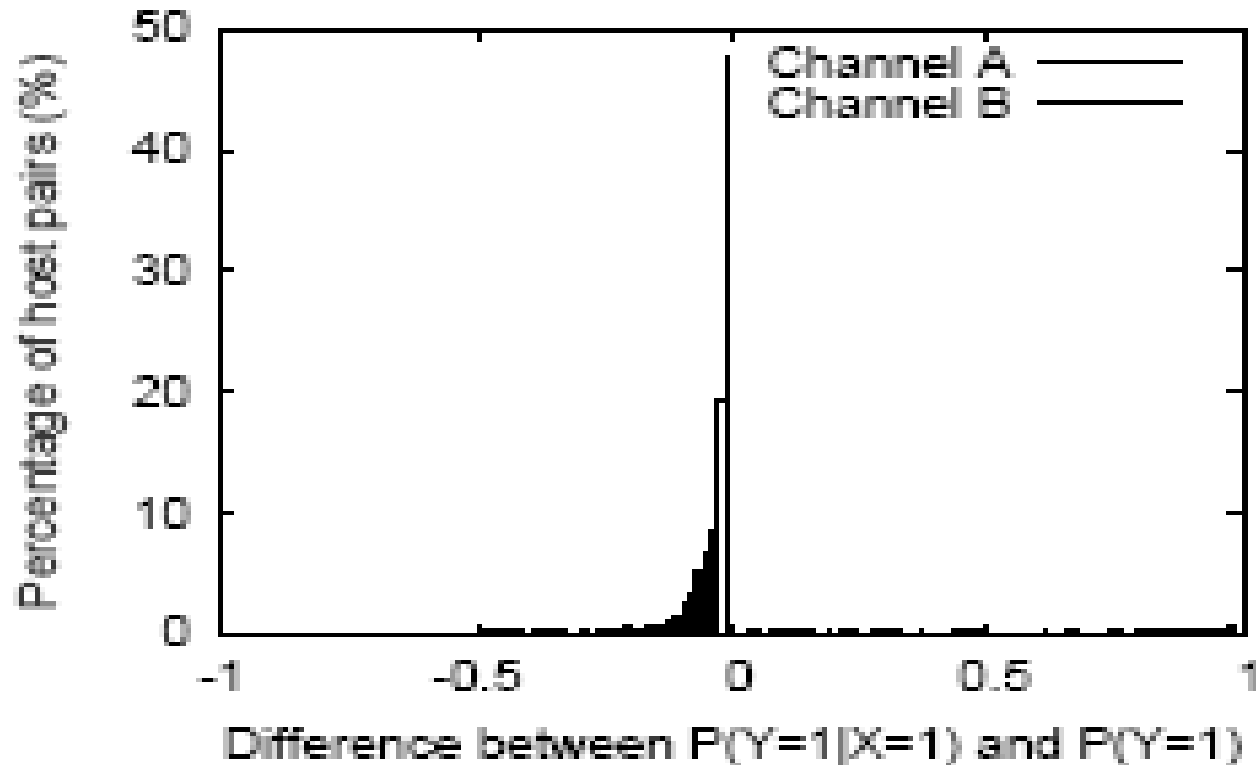


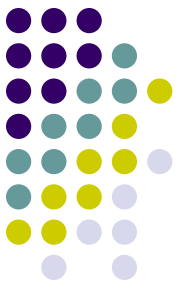
Findings



- Peer Availability – Bimodal Relation

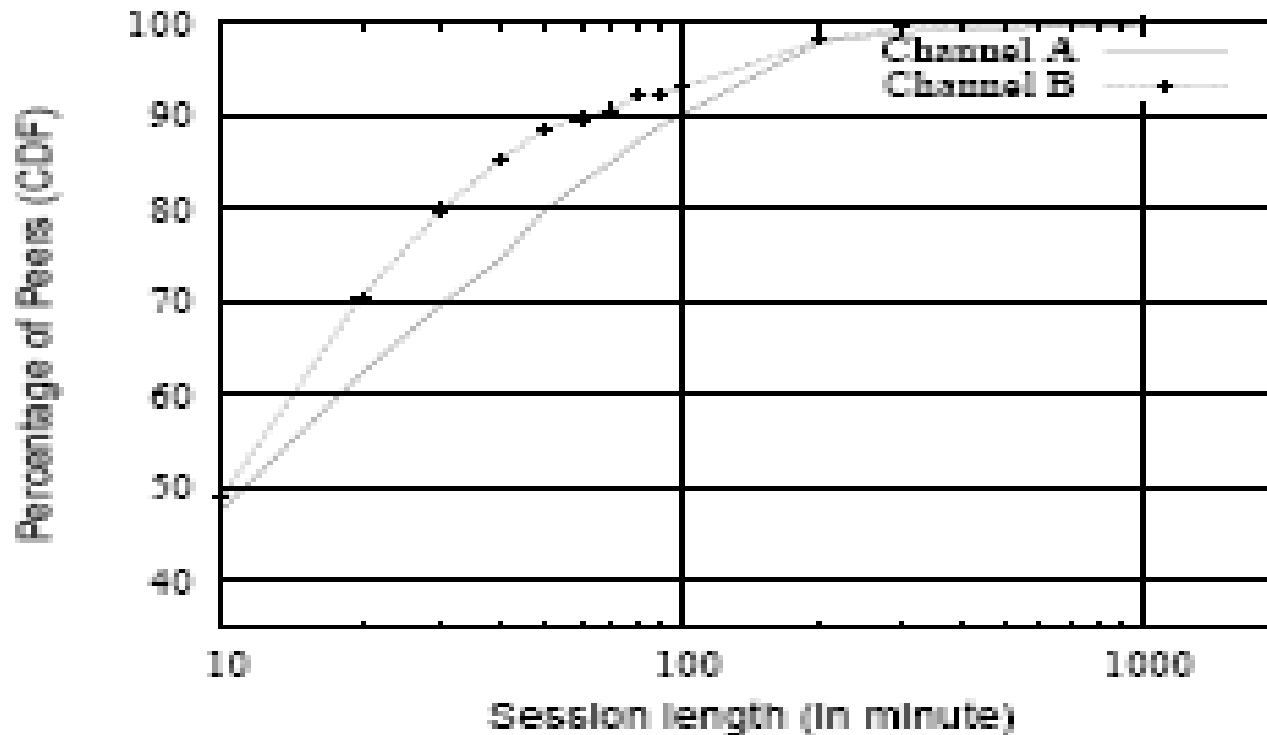
- Nodes in same snapshot have correlated availability
- Random node pairs have independent availabilities

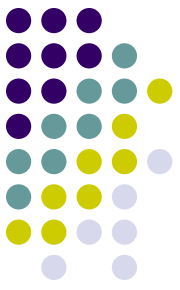




Findings

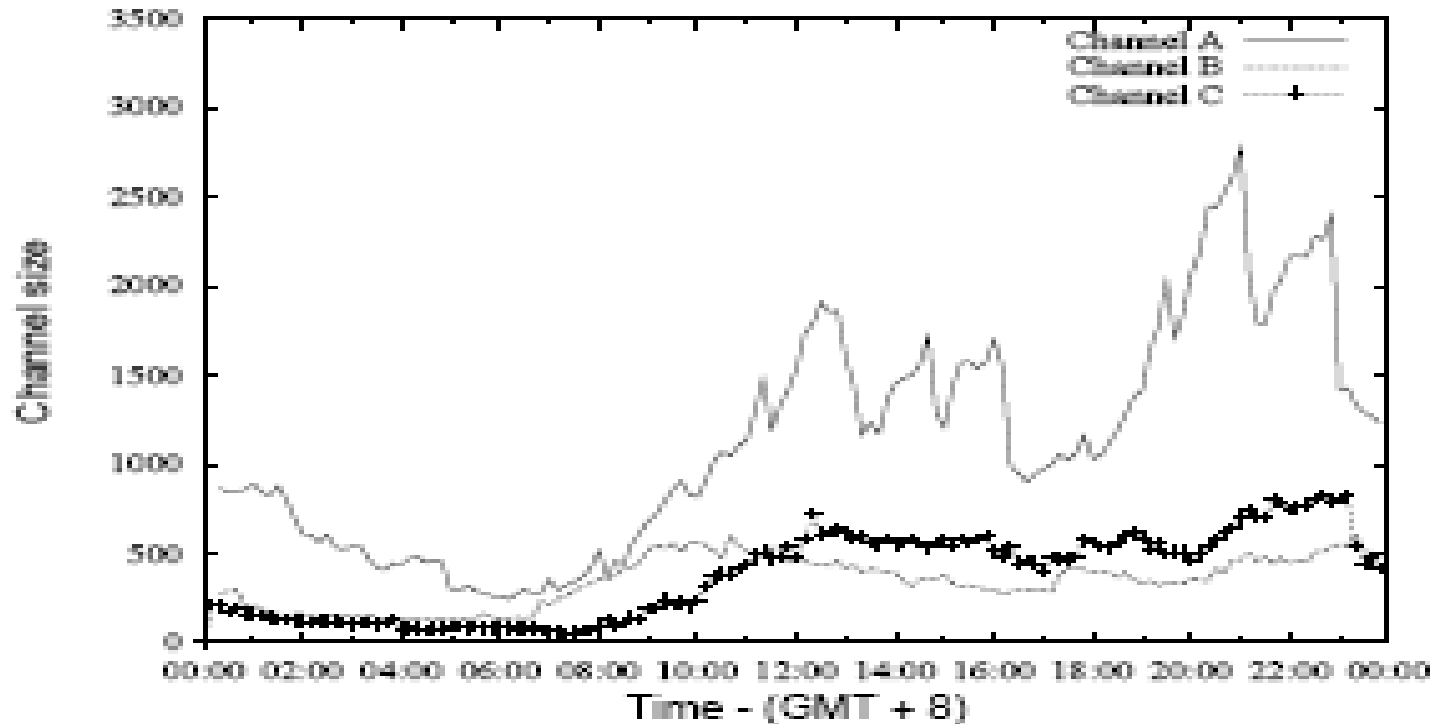
- PPLive peers are impatient





Findings

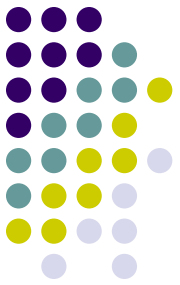
- Channel Population varies widely over a day
 - Channel population size variations are larger than in P2P file-sharing networks





Lessons Learned

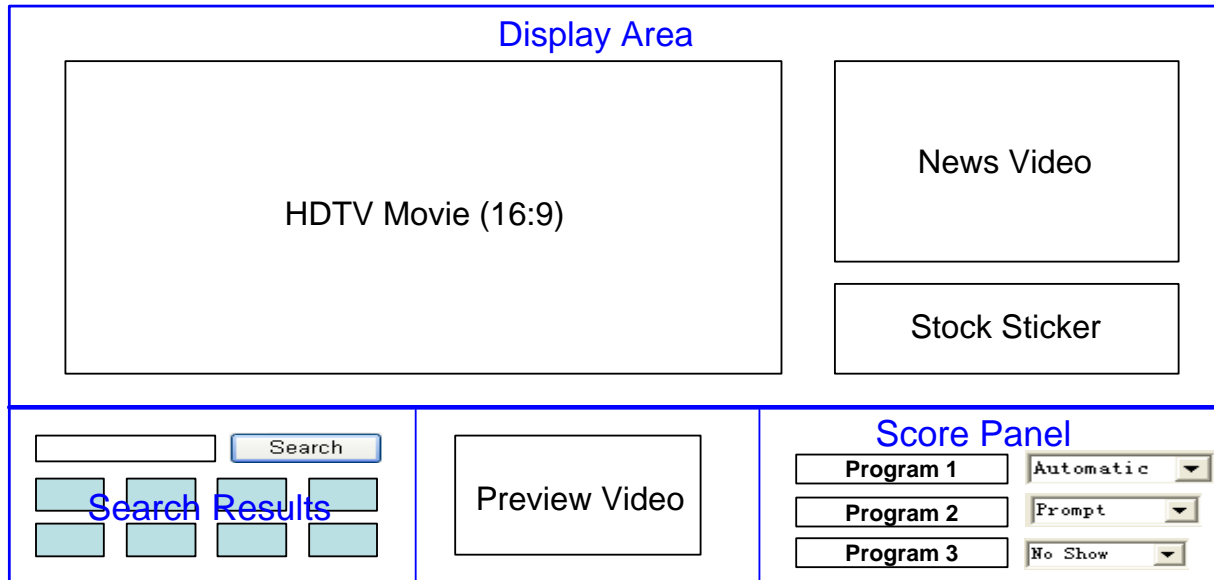
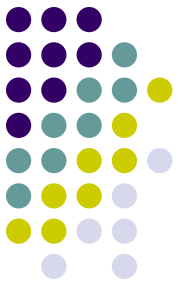
- Future media P2P streaming systems in their churn models need to take into account the bimodal distribution of peers availability
- Homogeneous protocols and homogeneous design proved to be quite good, i.e., the PPLive protocols that treated peers equally are simpler and seem efficient.
- User interfaces for IPTV could contribute more efficiently to the P2P overlay infrastructure
- More complex IPTV behavior is possible that needs to be taken into account by the P2P streaming systems



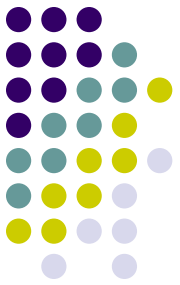
TV Channel Selection

- **Problem:**
 - Enable TV channel selection based on
 - user interest
 - channel content
- **Solution:**
 - Proactive TV channel search
 - Asynchronous notification

TV Channel Selection User Interface



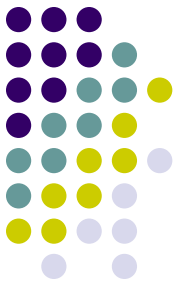
- Display area
- Search and preview
- Interest specification



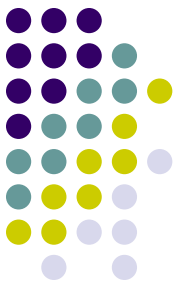
View Customization

- **Problem:**
 - How to render multiple channels for simultaneous viewing (aka. display management)
- **Solution:**
 - Automatic screen layout algorithm that considers
 - Visual effects (visually pleasing)
 - Screen utilization

Efficient Media Streaming



- **Problem:**
 - How to ensure
 - efficient network resource usage when there are large number of video streams
 - best user experience given bandwidth constraint
- **Solution:**
 - Semantic-aware bandwidth allocation among channels
 - Locality-aware P2P media streaming



Conclusion

- Opportunities: Sharing Measurement Data/Information
 - We have posted selected snapshots from the PPLive crawler study on our website
<http://cairo.cs.uiuc.edu/~longvu2>
- Issues:
 - Content rights management – permission to have TV content on IPTV
 - Encoding schemes – too many video formats, need to agree on certain TV content format (MPEG2 ?)
 - Home network content delivery – people are connected via very different networks
 - QoS/resource management – people will want TV quality on IPTV channels in near future.