Channel Selection Problem in Live IPTV Systems

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ABSTRACT

In this poster, we argue that understanding the channel selection behaviors of users can be used to improve their channel selection experience in live IPTV streaming systems.

Categories and Subject Descriptors

C.2.m [**Computer Systems Organization**]: Computer-Communication Networks—*Miscellaneous*

General Terms

Design, Measurement

Keywords

IPTV, channel switching

1. MOTIVATION

A large and a rapidly growing number of Internet live streaming services provide a rich set of audio, video, and TV content. Internet radio services provide audio broadcasts from thousands of public radio stations and even more private ones. Examples are websites like `jango.com`, `shoutcast.com`, `radio-locator.com`, and `deezer.com`. Live streaming of video and TV has increased dramatically over the past few years, following the increase in broadband penetration. Popular services like Joost, MobiTV, PPLive, BeelineTV, and FreeeTV allow users to watch thousands of live TV stations worldwide.

If we look back on the engineering and research advances in live streaming systems, the networking community has devoted extensive efforts on assuring the quality of streaming. These efforts include some of the advanced techniques developed on routing, caching, and prefetching of multimedia content. With the recent boom in the Internet TV (IPTV) market, research attention has shifted to the challenges of designing efficient distribution systems and reducing channel switching delay. However, existing work ignores the channel selection process, a fundamental feature of streaming.

When watching television, people browse through a set of on-air programs until they find something interesting. Channel selection while listening to the radio is similar; listeners sample and switch across multiple radio stations. Channel selection involves two steps: (a) sampling the content to decide whether to continue or stop watching the channel, and (b) switching across multiple channels for repeated sampling, until a desired channel is found. Consider a TV viewer changing channels after watching them for 5, 3, 10 seconds, and 20 minutes. We may interpret that the user sampled four channels before finding something interesting. The problem of quickly finding the right channel becomes harder as the number of channel offerings grows in modern IPTV systems.

We believe that future live streaming systems must focus on the problem of channel selection to improve user experience. To date, few studies have characterized user behavior when selecting channels, and the exact dynamics of it are not well understood. We use traces from a large-scale commercial IPTV service to study how users select channels in the real-world. Motivated by our findings, we propose a system that can potentially improve user experience by reducing the number of channels they need to sample before finding something that interests them.

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2. CHANNEL SELECTION DYNAMICS

As a representative streaming service, we use existing IPTV data [1] for analysis. The dataset contains a large collection of second-by-second TV viewing logs from a commercial IPTV service. The system provides 150 live TV channels to over a quarter million users, which gives us a unique opportunity to study channel selection mechanisms. The IPTV system studied responses to a channel change signal well below one second, i.e., channel switching delay is less than one second. Using a week-long trace, we investigate the two key mechanisms of channel selection, related to the following questions: (a) how long do people sample a channel before deciding whether to continue or stop watching, and (b) how many channels do people sample prior to viewing. Answering these questions not only identifies the significance of sampling activity in television viewing, but also indicates the level of possible degradation in user experience, as large values in sampling duration and frequency may indicate annoyed users.

2.1 How long does a single sample take?

We conduct a trace-driven analysis to answer this question. Our trace showed that over 60% of a user's channel switching happened within 10 seconds, indicating a large fraction of user action is related to channel selection. To infer the sampling duration, we examined the sojourn times of channel switchings that occurred within one minute. As it is not easy to demarcate viewing from sampling events, we

conservatively use a viewing threshold of one minute[1]. The average and the median sojourn times were 9 and 6 seconds, respectively. Table 1 shows the breakdown of the average sampling duration across different channel genre. Sampling duration for news is the shortest, while those of documentaries and movies are the longest. This reflects that people decide quickly on whether or not to watch news, but decide more slowly for documentaries and movies.

Table 1: The average time spent in sampling a single TV program across channel genre.

News	Children Music, Sports	Free-to-air Cable-like	Documentaries Movies
4 sec	7-8 sec	9 sec	10-13 sec

2.2 How many times do people sample prior to viewing?

Figure 1 shows the cumulative distribution function of the average number of samples prior to viewing a particular channel for longer than 1 minute for all users. Users sample 4 channels on average before each viewing event. On one end, 10% of users watch the first channel they switch into. It is possible that these users visit only a few of their favorite channels to alleviate the channel selection effort, however they could potentially be missing out on interesting programs on other channels. On the other end, 10% of users sample on average 6-100 times prior to viewing. This demonstrates the channel selection process takes up a significant fraction of TV viewing activity for some users who can clearly benefit from a system that assists channel selection.

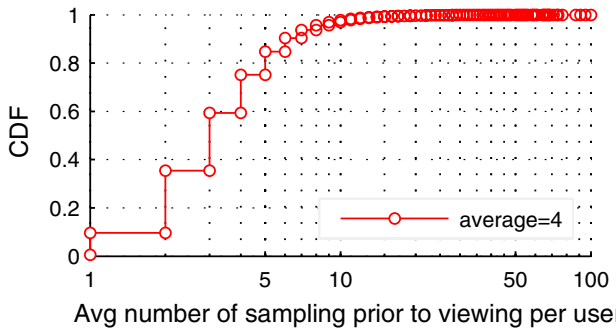

Figure 1: TV viewers sample 4 channels on average before watching anything for longer than 1 minute.

3. CHANNEL SELECTION SUPPORT IN EXISTING SYSTEMS

There are various forms of support for channel selection in current live streaming systems. One area of support is to help users find the right channel quickly. Users are provided with additional information about content or the list of recommendations, for example, the electronic program guide (EPG) in IPTV and "Most Popular Stations" in SHOUTcast. A second strategy is to make new content available quickly at the time of channel switching. This is more challenging for high-bandwidth video and TV streaming, especially in peer-to-peer (P2P) distribution systems. For instance, the state of the art P2P Internet TV service, Joost, takes up to 5 seconds to switch channels. This is not satisfactory considering that there are several hundreds of channels users can choose from. Typically 100-200 milliseconds switching delay is considered "instantaneous" by viewers. Much current research is focusing on the speed of channel switching.

[1]The Nielsen Media Research [2], which is the largest provider of television audience measurement, also demarcates viewing events by the minute.

4. PROPOSAL: REDUCING UNNECESSARY SAMPLING

We propose a system that reduces unnecessary sampling. We generate a "hotlist" – a list of channels based on the real-time popularity of content and the user's past streaming history – and allow users to switch amongst the channels recommended in the hotlist. In IPTV, this can be realized as an alternative way to change channels, compared to the conventional linear (up or down) changes. As users surf through our hotlist, they are likely to find interesting programs with less number and time spent on sampling, which improves the user experience.

Our approaches to generate the hotlist is to organize channels based on the real-time popularity. The hotlist can be customized for each geographical location and for each content genre to reflect the locality and viewing preferences of users. For example, our trace showed that viewers in the same area tend to watch programs on similar topics. Finally, the hotlist can be personalized to reflect the past viewing history of individual users.

From the networking perspective, the use of hotlists reduces the load of video servers and cuts down on network traffic. We expect such benefits to be significant because channel switching in live streaming services is often synchronized (e.g., users switch during the commercial break of Olympic games). Because the system needs to be provisioned for peak usage, reducing intermediate switching has a significant impact. The scale of the impact depends on the system design, for instance, benefits may be smaller for hierarchical channel listings than for linear ones. Nevertheless, as long as users are selecting channels, reducing intermediate switches will have a positive impact.

We are currently working towards building a prototype system for reducing switching in IPTV. As a first step, we are analyzing the detailed channel switching behaviors of users and exploring the opportunities for using the local popularity of particular channels. We are also investigating the exact savings on network and system load from a reduction in channel switching.

5. REFERENCES

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[2] The Nielsen Media Research. `http://www.nielsenmedia.com`.