

Networking for Multimedia

Tech Topic #04: Multimedia Applications

K. Almeroth and M. Ammar, "An Alternative Paradigm for Scalable On-Demand Applications: Evaluating and Deploying the Interactive Multimedia Jukebox," IEEE Transactions on Knowledge and Data Engineering Special Issue on Web Technologies, vol. 11, num. 4, pp 658-672, July/August 1999.

Certainly an epic paper insofar as it presents nothing less than a new sub-area for multicast applications, complete with critical research problems, an existing and even somewhat vetted prototype, as well as simulations showing scalability and general betterness. Published in IEEE Transactions on Knowledge and Data Engineering, it focuses on a new system concept for content delivery and largely ignores certain technical details such as particular routing infrastructure, which is most likely why the paper did not appear in IEEE Networking or the related.

The second section presents the new paradigm very neatly in the middle of the content delivery spectrum between true-blue unicast-stream video-on-demand and traditional broadcast television. One of the major technical decisions to be discussed in the paper is the choice of scheduling policy when filling program requests, and this section outlines five scheduling choices: shortest wait, content-based, service provider, vote-based and alternate choice-based. A system-level architecture diagram concludes the section.

The third section describes a prototype implementation of the multimedia jukebox system in question. The paper has the (relatively large) advantage of several years of deployment data and characteristics, lending a certain amount of weight to the work in spite various critiques.

Section 3.3 discusses possible mechanisms for tracking usage under the jukebox system but neglects to mention privacy considerations when collecting user behavioral data such as who, when and what programs are requested, perused, and viewed. While this information is rarely thought of as intrusive to collect in the arena of web technologies, a system intended to replace broadcast television might consider user attitudes during migration. An alternate way to think about this would be to pose the question of how one's usage of interactive TV guide functionality might change if they thought all their actions would be recorded and used by the cable company for tracking purposes.

In the fourth section a series of simulations are performed in an attempt to show how the multimedia jukebox concept can scale to very large numbers of users. In general, the factors varied are the previously-discussed scheduling policies. The simulations in this paper are very cool in the sense that they are able to leverage some of the data collected over several years from a deployed prototype—not very many number of papers are able to do this.

For the most part, the selection of parameters and metrics for the simulation are well-justified, with the very tricky exception of user behavior. Users are of course almost impossible to simulate effectively, but at the same time it is very difficult not to include aspects of user behavior when simulating a system-level concept such as the multimedia jukebox. Here the authors do an excellent job of not only disclosing but also discussing the assumptions made and why they might be valid. The paragraph on “well-behaved” users is a good example of this. The “alternate-user choice” scheduling policy discussion also demonstrates a good use of explicit disclosure of assumptions regarding user behavior, although in this case the rationale is much more intuitive. The ideas of channel surfing, or going to a store without knowing what to rent, appear as intuitive motivations for the work and themes throughout.

Section 5 briefly outlines several relatively disparate concepts grouped under the common heading of “advanced jukebox services”. Interactivity (“Tivo-like services”) is separated into two camps: Limited and Full. It was not clear from the description what limited interactivity implied, neither from the end-user's perspective nor an implementation standpoint. A more in-depth discussion on full interactivity (or providing interactivity in general) could have been provided, including its impact on system resources, scheduling choices and the user device's role. Although, the reviewer recognizes it is easy to ask for this now given the prevalence of full interactivity today; 12 years ago it was far from a given that such a service would be considered standard fare in less than a decade.

Certain combinations of distributing jukebox servers and interfaces are briefly presented. In short, these are not particularly fascinating suggestions, except for possibly the “anycast”-style interface. A potentially interesting technical question might be how to distribute services given that there could be a varying number of available channels at different points in the system.

Overall, the paper positions itself as a paradigm shift, but it was not entirely clear why we needed the shift. It was beautifully clear where on the spectrum between VoD and traditional television the multimedia jukebox concept fit in, but reasoning for why we needed to replace broadcast television in the first place was somewhat lacking. As an *addition* to current offerings the system made more sense, but the paper appeared to imply throughout that the multimedia jukebox was to serve as a *replacement* for both extremes of true VoD and traditional broadcast television—this was particularly true in the “service pricing” section.

It is difficult to present a full end-to-end concept without asking the ever-present question of Who's Paying. Because this is a well-written paper, the authors dutifully do this, but missing from their analysis is the notion that content providers and service providers are rarely the same entity. Perhaps edging more towards what might be in a preliminary business case for the paper, nevertheless it is probably worth asking who would accumulate and control the library in a commercial system? Obviously a content provider would have a difficult time procuring programming from competitors. Service providers may find it difficult to justify the expense. And a jukebox with an empty library most likely sits in a corner gathering dust.

On the other hand, if the multimedia jukebox concept were in fact to extend, rather than completely replace, existing entertainment options, we are back to guessing at user acceptance and behavior. Again we have the benefit of a decade of observation, and a simple example shows the continued dominance of broadcast media (perhaps augmented with Tivo-like functionality): the reviewer's wife enjoys *House, M.D.*, and will frequently land on the program when flipping channels. However, despite the fact that various on-demand applications exist for watching *any* episode at her leisure, she will nonetheless record broadcasts as they air for later watching rather than utilize available VoD functionality. This is, of course, a hand-picked example, and a serious study of such behavior could take an entire research topic of its own. But it serves to point out that broadcast media is still king, and a more in-depth comparison (or treatment of why it was not sufficient) may have been appropriate.

At the end of the day, a bit of slack can certainly be granted in terms of motivation if it serves (as it does in this paper) as an excellent vehicle to present results from a very interesting prototype. A good paper, even, perhaps could have stopped there, but to further extend the research with detailed simulation results and ancillary service concepts serve to give the paper a deserved status as journal article.