DTVideo: Information-Centric DTN Video Distribution

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1. INTRODUCTION

I previous projects, we have built a Delay Tolerant Networking (DTN) system for the local population of the Padjelanta national park in Swedish Lapland. This area is very remote and does not have access to traditional communication infrastructure. In this work, we build on previous research, and also bring in a new networking paradigm known as Information Centric Networking (ICN) and combine that with our DTN experience.

A large portion of Internet traffic today consists of video content. It is likely that users in a remote community will also be interested in this content – in particular content like the most recent news broadcast that can not be preloaded while at a well-connected point. The problems are that the size of this type of content is large, which leads to high system resource usage when retrieving it. This becomes worse when multiple users in the same region download the same popular content and waste resources by transmitting the same bits multiple times. As it is common that many users wants to access the same content (e.g., the latest news broadcast), we saw the potential to leverage the benefits of ICN in conjunction with DTNs by making intermediate nodes aware of the name of the content requested and allowing them to cache the content to serve subsequent requests from their local cache. Thus, we have developed and implemented DTVideo, a video distribution service over DTNs that make use of the BPQ extension [1] to the Bundle Protocol [2] to leverage caching in the network. In this demo, we will show a simplified setup of the system deployed in the field and demonstrate how this was used, and how the use of BPQ dramatically reduces the resources usage of the system.

The only logistical requirements for the demo are a table, a poster board, and four power outlets.

2. SYSTEM OVERVIEW

The DTVideo system was implemented and used in a real remote deployment in the Swedish mountains. Figure 1 shows a simplified overview of the system and its different components, including components running on machines in the connected Internet. On the nodes, we run a combination existing software and software developed within this project. This section will explain the different components of that system.

Figure 1: DTVideo system overview.

2.1 DTN2 - Bundle Protocol and BPQ

Communication in DTNs use the Bundle Protocol for addressing, encapsulation, and end-to-end connectivity of nodes. We use the freely available DTN2 reference implementation of the Bundle Protocol architecture. The Bundle Protocol Query (BPQ) extension block is a proposed extension to the Bundle Protocol that combines DTNs and ICNs and allows requested named content to be cached in the network so that future requests for the same content can be more efficiently served.

2.2 DTVideo

Video Source.

The system needs a video source that generates the content to be distributed. This can be a static video library, recorded versions of tv programs, or user generated content (for a service similar to YouTube). This video source updates the list of available video programs at the video server as new content become available.

Video Server / BPQ Request Responder.

The video server operates in the same connected domain as the video source – in most configurations, this would mean that the video server is connected to the Internet.

The DTN2 daemon on the video server must be aware of the BPQ extension block. The video server runs a program that listens for incoming requests for a specific endpoint identifier (EID). When a request arrives, it consults its local database of video content, and if a program with the requested name is available, it is sent back to the requesting EID (with the BPQ block set to indicate that this is a response for that particular name).

Intermediate DTN Nodes.

Not all nodes in the DTN between the video source and the end user need to be aware of the BPQ extension. The nodes that are BPQ compatible will participate in the caching and querying of video bundles, but one of the benefits of using an extension block for BPQ is that nodes that lack this functionality can ignore the BPQ block and forward the bundle to its destination. Thus, not all nodes in a network have to be upgraded to deploy this, but only those where caching is believed to be beneficial.

BPQ DTN Gateway.

The main way for users to interact with the DTVideo service is through a web interface, run at each node that want to be able to use the service. In the main screen of the user interface, the user can see a list of video programs that are available in the system. As new programs are made available at the video server, this list will be automatically updated (of course with some delay). The user interface shows if the video is remotely available, if it has already been requested, but the response for it is still pending, or if is already locally available for viewing. If the video is locally available, the user can launch a video player to watch it. If it hasn't been requested yet, the user can issue a request for that program. When the user does this, the software described above is launched that creates a BPQ request and send that bundle to the video server.

3. REFERENCES

[1] S. Farrell, A. Lynch, D. Kutscher, and A. Lindgren. Bundle protocol query extension block. Technical Report draft-farrell-dtnrg-bpq-00, IRTF, Nov. 2010.

[2] K. L. Scott and S. Burleigh. Bundle protocol specification. Technical Report RFC5050, IRTF, Nov. 2007.