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THROUGHPUT ANALYSIS OF A PATH IN ROUTING FRAMEWORK FOR VIDEO TRAFFIC IN WIRELESS NETWORK

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Abstract:
Traditional routing metrics designed for wireless networks are application agnostic. In this paper, we consider a wireless network where the application flows consist of video traffic. From a user perspective, reducing the level of video distortion is critical. We ask the question "Should the routing policies change if the end-to-end video distortion is to be minimized?" Popular link-quality-based routing metrics (such as ETX) do not account for dependence (in terms of congestion) across the links of a path; as a result, they can because video flows to converge onto a few paths and, thus, cause high video distortion. To account for the evolution of the video frame loss process, we construct an analytical framework to, first, understand and, second, assess the impact of the wireless network on video distortion. The framework allows us to formulate a routing policy for minimizing distortion, based on which we design a protocol for routing video traffic. We find via simulations and tested experiments that our protocol is efficient in reducing video distortion and minimizing the user experience degradation.
Key words —Protocol design, routing, video communications, video distortion minimization, wireless networks.

1. INTRODUCTION

video traffic has become very popular in wireless networks. In tactical networks or disaster recovery, one can envision the transfer of video clips to facilitate mission management. From a user perspective, maintaining a good quality of the transferred video is critical. The video quality is affected by: 1) the distortion due to compression at the source, and 2) the distortion due to both wireless channel induced errors and interference. Video encoding standards, like MPEG-4 [1] or H.264/AVC, define groups of I-, P-, and B-type frames that provide different levels of encoding and, thus, protection against transmission losses. In particular, the different levels of encoding refer to: 1) either information encoded independently, in the case of I-frames, or 2) encoding relative to the information encoded within other frames, as is the case for P- and B-frames.

RELATED WORK

Group of Pictures (GOP) allows for the mapping of frame losses into a distortion metric that can be used to assess the application-level performance of video transmissions. One of the critical functionalities that is often neglected, but affects the end-to-end quality of a video flow, is routing. Typical routing protocols, designed for wireless multihop settings, are application-agnostic and do not account for correlation of losses on the links that compose a route from a source to a destination node. Furthermore, since flows are considered independently, they can converge onto certain links that then become heavily loaded (thereby increasing video distortion), while others are significantly underutilized. The decisions made by such routing protocols are based on only network (and not application) parameters. Our thesis is that the user-perceived video quality can be significantly improved by accounting for application requirements, and specifically the video distortion experienced by a flow, end-to-end. Typically, the schemes used to encode a video clip can accommodate a certain number of packet losses per frame. However, if the number of lost packets in a frame exceeds a certain threshold, the frame cannot be decoded correctly. A frame loss will result in some amount of distortion. The value of distortion at a hop along the path from the source to the destination depends on the positions of the unrecoverable video frames (simply referred to as frames) in the GOP, at that hop. As one of our main contributions, we construct an analytical model to characterize the dynamic behavior of the process that describes the evolution of frame losses in the GOP (instead of just focusing on a network quality metric such as the packet-loss probability) as video is delivered on an end-to-end path. Specifically, with our model, we capture how the choice of path for an end-to-end flow affects the performance of a flow in terms of video distortion.

3. PROPOSED SYSTEM

In this paper, our thesis is that the user-perceived video quality can be significantly improved by accounting for application requirements, and specifically the video distortion experienced by a flow, end-to-end. Typically, the schemes used to encode a video clip can accommodate a certain number of packet losses per frame. However, if the number of lost packets in a frame exceeds a certain threshold, the frame cannot be decoded correctly. A frame loss will result in some amount of distortion. The value of distortion at a hop along the path from the source to the destination depends on the positions of the unrecoverable video frames (simply referred to as frames) in the GOP, at that hop. As one of our main contributions, we construct an analytical model to characterize the dynamic behavior of the process that describes the evolution of frame losses in the GOP (instead of just focusing on a network quality metric such as the packet-loss probability) as video is delivered on an end-to-end path. Developing an analytical framework to capture the impact of routing on video distortion as our primary contribution, we develop an analytical framework that captures the impact of routing on the end-to-end video quality in terms of distortion. Specifically, the framework facilitates the computation of routes that are optimal in terms of achieving the minimum distortion. The model takes into account the joint impact of the PHY and MAC layers and the application semantics on the video quality. Design of a practical routing protocol for distortion-resilient video delivery: Based on our analysis, we design a practical routing protocol for a network that primarily carries wireless video. The practical protocol allows a source to collect distortion information on the links in the network and distribute traffic across the different paths in accordance to:
1) the distortion,
2) the position of a frame in the GOP.

4. SYSTEM DESIGN:

Data Flow Diagram / Use Case Diagram / Flow Diagram:

- ❖ The DFD is also called as bubble chart. It is a simple graphical formalism that can be used to represent a system in terms of the input data to the system, various processing carried out on these data, and the output data is generated by the system
- ❖ The data flow diagram (DFD) is one of the most important modeling tools. It is used to model the system components. These components are the system process, the data used by the process, an external entity that interacts with the system and the information flows in the system.

- DFD shows how the information moves through the system and how it is modified by a series of transformations. It is a graphical technique that depicts information flow and the transformations that are applied as data moves from input to output.

DFD is also known as bubble chart. A DFD may be used to represent a system at any level of abstraction. DFD may be partitioned into levels that represent increasing information flow and functional detail.

5. SYSTEM ARCHITECTURE

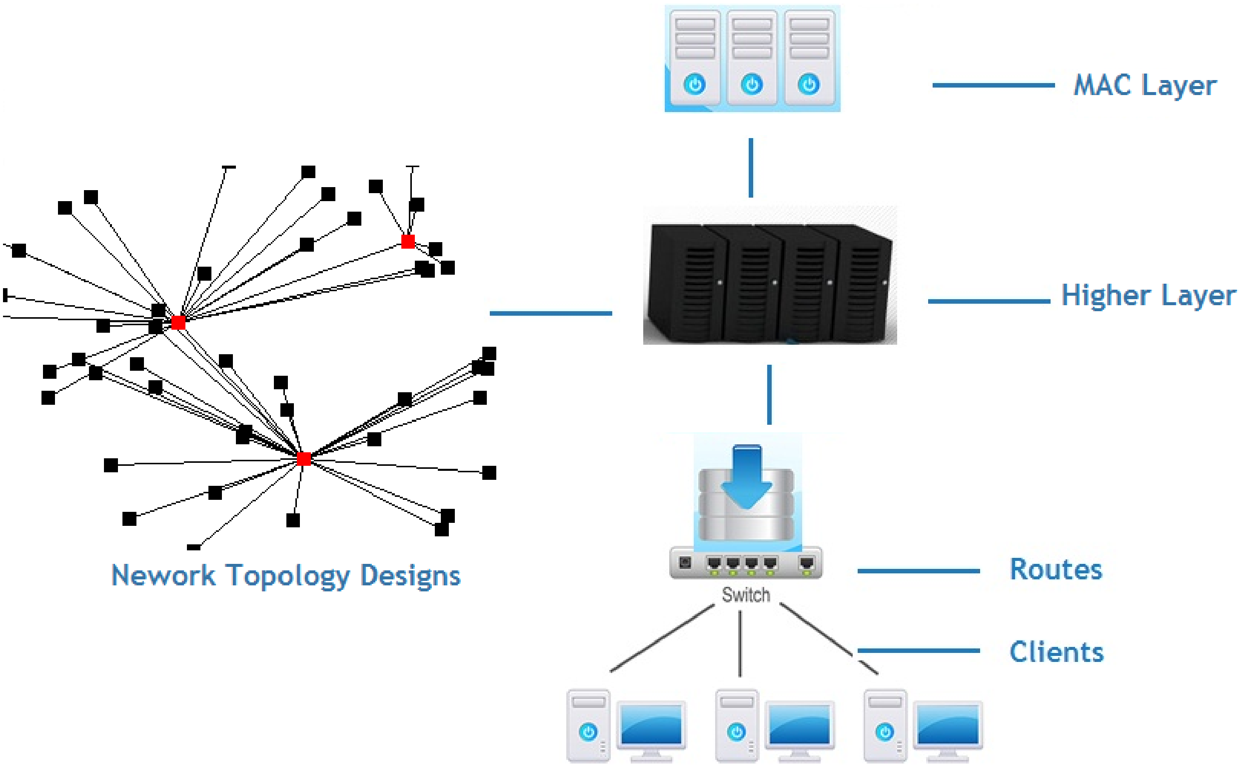

Fig.1.System architecture

RESULT ANALYSIS

Our main contributions, we construct an analytical model to characterize the dynamic behavior of the process that describes the evolution of frame losses in the GOP (instead of just focusing on a network quality metric such as the packet-loss probability) as video is delivered on an end-to-end path. Specifically, with our model, we capture how the choice of path for an end-to-end flow affects the performance of a flow in terms of video distortion. Dynamic nature and distributed operations of a network, such complete knowledge of the global state is not always available to the nodes. In practice, the solution to the MDR problem can be computed by the source node based on partial information regarding the global state that it gathers. The source node has to sample the network during a path discovery process in order to collect information regarding the state of the network. The sampling process includes the estimation of the ETX metric for each wireless link in the network. These estimates provide a measure of the quality of the links. The estimation process can be implemented by tracking the successful broadcasting of probe messages in periodic time intervals.

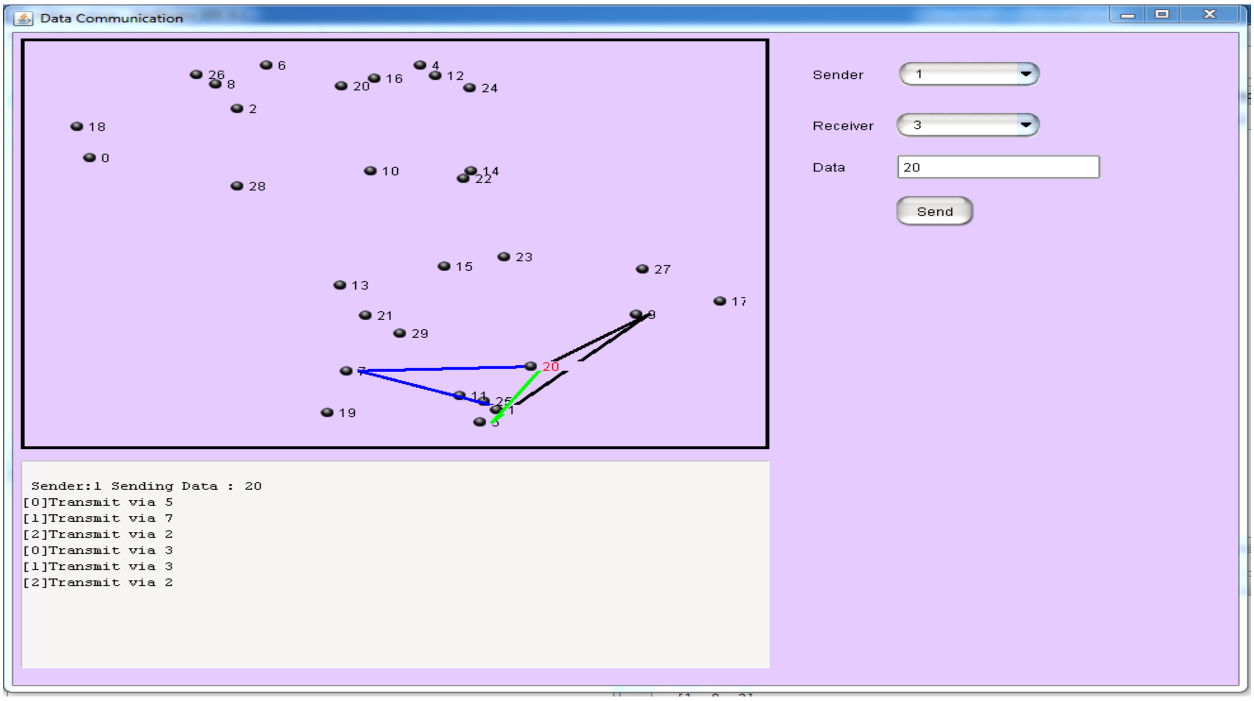

Fig.2.Result analysis

The ETX estimates computed locally in the neighborhood of a node are then appended in the Route Request messages during the Route Discovery phase. Upon reception of this message by the destination, a Route Reply message is sent back to the source that contains the computed ET.

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