April 01, 2019

Using time series variations in streaming content as a stream status identifier

Simon Smith

Using time series variations in streaming content as a stream status identifier

ABSTRACT

Streaming content can be distributed over a network from sources, e.g., auditoriums, conference rooms, etc., to destinations, e.g., offices, other conference rooms, etc. There is a need to ensure that such a network, e.g., a corporate network, transport a content stream originating from a certain source provides it to the intended destination and only that destination. This verification needs to be performed without accessing the content of the stream itself. This disclosure describes techniques that form a signature of a content stream based on variations in its time series, e.g., by measuring bandwidth values of a certain number of frames. Signatures are obtained at source and destination. If the signatures match, connectivity is confirmed.

KEYWORDS

- Audiovisual network
- Content stream
- Stream status identifier
- Audiovisual telemetry
- Content signature
- Stream transport
- Source-destination connectivity

BACKGROUND

A corporate campus can connect sources of streaming content, e.g., auditoriums, conference rooms, etc., over a network to destinations, e.g., offices, other conference rooms, etc. Personnel that maintain such a network have the responsibility to ensure that a content stream originating from a certain source reaches the intended destination and only that destination. Such

personnel are generally not privy to the content of the stream itself; yet they need a way to verify that a certain source stream has reached a certain destination. The use of supplementary metadata streams to verify source-destination connectivity has proven unreliable, as it is the case sometimes that the supplementary stream reaches the destination but not the content stream itself. With replacement of older, point-to-point distribution networks by newer, more sophisticated, point-to-multipoint networks, this problem has become acute in recent years. The newer networks are more complex, and can be susceptible to failures that prevent receipt of the stream at the destination despite being correctly configured and operational. For example, the various layers of the network can prevent the video stream from being decoded but allow other signals to pass.

DESCRIPTION

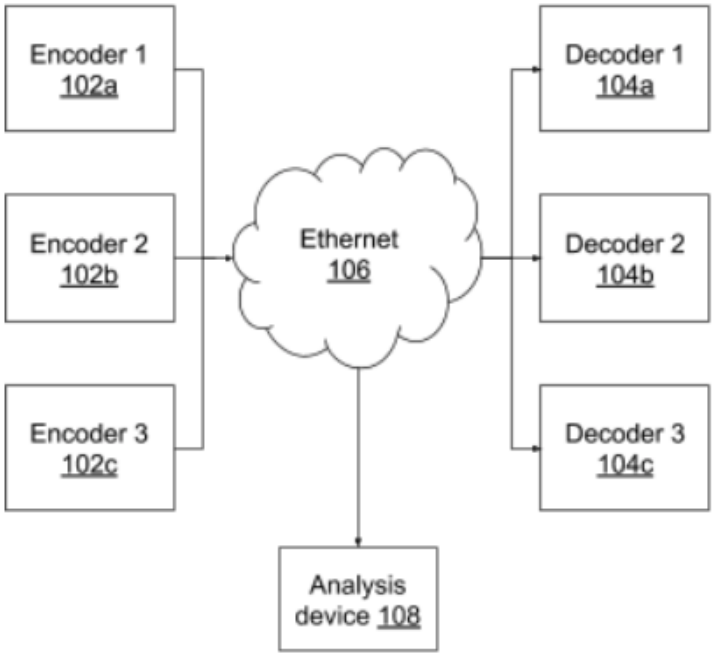

Fig. 1: Determining source-destination connectivity

Fig. 1 illustrates determination of connectivity between a given source and a given destination in an audiovisual network, per techniques of this disclosure. Content sources within an audiovisual network use encoders (102a-c) to encode content prior to transmittal to the audiovisual network, which can be, e.g., an ethernet (106). Destinations within the network use decoders (104a-c) to decode content that is intended for them. An analysis device (108) coupled to the network accepts encoded signals for given source-destination pairs and confirms their connectivity (or lack thereof) by matching the signatures of the encoded signals.

The encoders typically use low-latency, e.g., sub-frame, video standards to compress content to a fraction of its raw bandwidth. Since the content bandwidth is a function of the content itself, the content bandwidth serves as a signal to determine if the correct content is being received by a decoder. This content-bandwidth signal being a single number per frame, the content of the frame cannot be reconstructed from the content-bandwidth signal. The nature of audio-video signals is such that there is sufficient entropy between signals and between frames of signals to allow distinguishing between any two given streams even when the content is similar, since small variations lead to different compression outcomes. A content signature can therefore be generated by collating the content-bandwidth values of a certain number of frames.

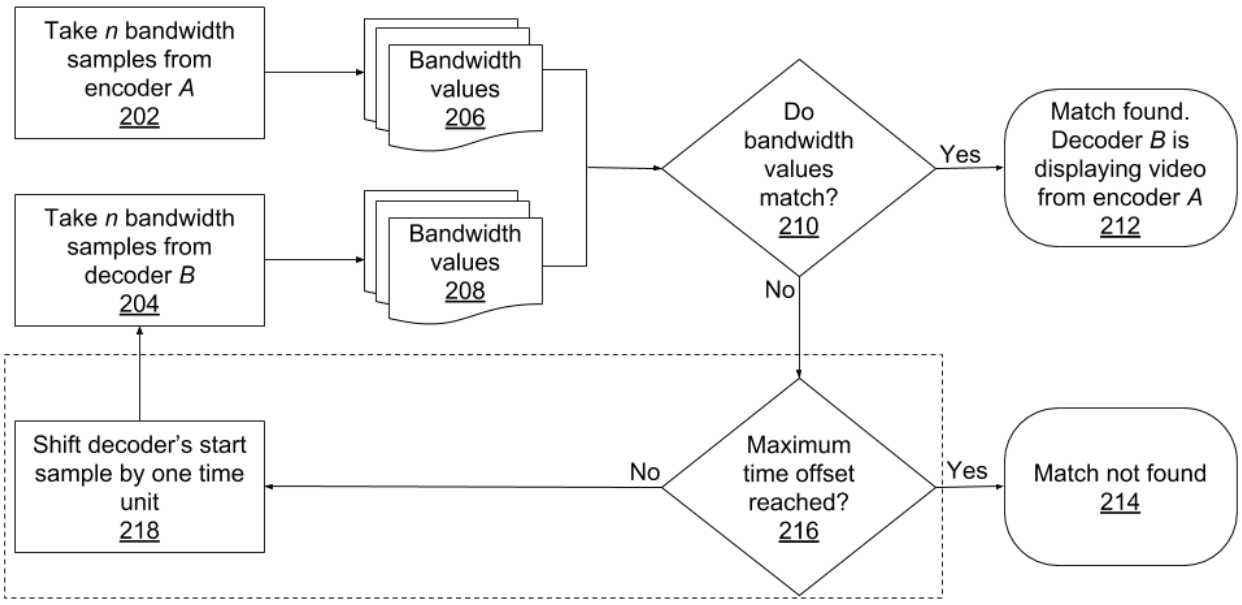

Fig. 2: Matching an encoder to a decoder

Fig. 2 illustrates matching a source (encoder A) on an audiovisual network with a destination (decoder B) on the same audiovisual network. The matching is based on the signatures of content streams at the encoder and the decoder. Encoder A and decoder B are matched if content from encoder A reaches decoder B.

Several bandwidth samples, e.g., ten samples, are taken from the output of encoder A (202). A similar number of bandwidth samples are taken from the input to decoder B (204). Content-bandwidth values are determined over several frames for the content streams at the encoder (206) and at the decoder (208). As mentioned before, content-bandwidth values serve as signatures for the content. If the content-bandwidth values match (210), then the encoder-decoder match is confirmed (212), e.g., decoder B is confirmed as displaying content from encoder A.

If the content bandwidth values do not match (210), then the possibility that the encoder and decoder are not precisely time-synchronized, e.g., due to network latency, is investigated (dotted rectangle). So long as a maximum time offset between encoder and decoder is not

reached (216), the start-time for collection of decoder samples is shifted by one time unit (218), and an encoder-decoder match is sought again. If, after investigating time offsets less than or equal to the maximum time offset, an encoder-decoder match is still not found (214), then decoder B is determined to not receive content from encoder A. Content signature can alternatively be obtained by averaging content-bandwidth over several frames.

In this manner, the integrity of the signal path between sources and destinations in an audiovisual network is tested without adding supplementary metadata signals and without viewing the content directly. The techniques amount to a form of telemetry, e.g., remote assessment, of the audiovisual network.

CONCLUSION

Streaming content can be distributed over a network from sources, e.g., auditoriums, conference rooms, etc., to destinations, e.g., offices, other conference rooms, etc. There is a need to ensure that such a network, e.g., a corporate network, transport a content stream originating from a certain source provides it to the intended destination and only that destination. This verification needs to be performed without accessing the content of the stream itself. This disclosure describes techniques that form a signature of a content stream based on variations in its time series, e.g., by measuring bandwidth values of a certain number of frames. Signatures are obtained at source and destination. If the signatures match, connectivity is confirmed.