USE OF NON-BINARY VT-CODES IN NETWORK TRAFFIC WATERMARKING

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According to the current level of telecommunications development, 5G communication systems are expected to provide higher data rates, lower latency and improved scalability. To ensure the security and reliability of generated data traffic 5G networks must be designed to support security protocols and reliable communication applications. The error correcting codes have found many other uses, including watermarking and intrusion detection, cryptography and information security. The input patterns, which are easily identified when the watermarked flows cross an observation point, allow the creation of a mechanism to scan the network for the harmful activity.

If the embedded watermark is both reliable and unique, it is possible to analyze the watermarked return traffic and trace it back at intermediate nodes. This TA approach is referred to as the "flow watermarking" (FW). FW is often implemented on the basis of inter-packet-delay (IPD) schemes, where watermark bits are embedded in the intermediate packet time which allows to hide traffic artifacts from an attacker.

Most FW technologies use a carrier that modulates the transfer of watermark data. Many FW schemes use the quantization-index modulation (QIM) watermarks into IPDs and added a layer of ECC to handle watermark desynchronisation and substitution errors.

To embed the watermark, the IPD flow is modified so that each IPD is converted to an interval according to the even/odd multiplier of the quantization interval $\Delta/2$, depending on the value of the 0/1 bit. Existing approaches for the implementation of binary QIM are well known and are given in [1]. One of the known FW scheme for embedding watermarks is based on the use of binary Varshamov-Tenengolz (VT) codes, which are subcodes of linear codes. This scheme uses linear codes with an attached marker and optional matrix interleaving to deal with bursting errors.

The evaluation of true positive rates (TPR) in the detection of watermarks have shown that they not do not exceed 10 %, but the TPR value drops to 66 % when the packet loss is 20 %, which is rare in a network environment. To eliminate artifacts caused by binary quantization of delays in the delivery of network packets and improve the detection of watermarks in traffic control, we proposed switching to multilevel QIM and using non-binary VT codes.

These codes have attracted interest, as evidenced by the publication [2], where an encoding method was proposed for a non-binary systematic VT code. The coding principle for these codes is similar to known binary ones. However, a systematic representation requires recoding the bit representation of symbols into a non-binary equivalent for their dyadic (multiple of a power of 2) representation. Therefore, the growing complexity of encoding-decoding is a price to pay for the resulting efficiency.

References

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