VI
Conclusion

The first aspect concerns the performance results of the LT code, when the erasure pattern, that combines random bursts and random punctual packet erasures, was employed in the simulation of the channel. From analyzing the curve presented in fig. V.1, it can be noted that very little decoding is possible in the LT decoder, up to approximately the overhead that is required to completely decode the original message.

The plot presented in fig. V.6 shows that throughout this interval, under eight percent overhead and for an error probability of three percent, the Reed-Solomon based schemes perform much better.

However, as soon as an amount of integral encoded symbols, of approximately what is required by the decoder to completely decode the incoming string, is reached, a behavior similar to a *decoding waterfall* is observed and the LT code performs better.

Furthermore, through subjective analysis of the decoded video, the quality is still not satisfactory within the overhead interval for which the single- and the two-dimensional Reed-Solomon codes outperform the LT code. In other words, at the point where the LT code completely decodes the incoming stream, the Reed-Solomon schemes still present visual degradation.

This can be verified subjectively in the sample frames shown in figures V.7, V.8 and V.9, for the LT code and for the single and two dimensional Reed-Solomon codes respectively, all employing the same overhead and an identical channel erasure pattern.

Considering the aforementioned, our first conclusion regarding the comparison between the Reed-Solomon schemes and the LT code in the simulation scenario presented herein, is that if the application is bandwidth critical, Reed-Solomon would be the scheme of choice, since at lower overheads — or higher loss rates — the LT decoder recovers almost no information, while the Reed-Solomon decoder is capable of recovering a significant amount of the original symbols. However, if the application is quality critical, in other words, if it is worth to have much higher quality, i.e., the original content completely de-

coded, at the cost of a slightly larger overhead, the LT code is the appropriate choice for this simulation scenario.

Other important aspects can also be concluded from the comparison between the three coding schemes, when different erasure patterns are employed. All patterns have the same erasure probability $P_{err} \approx 0.03$, differing in the erasure distributions, as explained in Chapter IV. From analyzing the results presented in figures V.6, V.4 and V.5, the following is observed:

- The performance for the LT code was more or less the same for all erasure patterns. This is a result of the larger LT packet sizes and of the Universality property of Fountain codes.
- When the erasure pattern comprises random bursts of packets only, the second dimension of the Reed-Solomon scheme does not present any improvement over the single dimensional one. Instead, it makes the performance worst. This is probably because the second dimension does not benefit from the interleaving, which distributes the burst losses and hence, it is not recovering a significant amount of erased symbols, that justifies the increase in overhead that is imposed upon its application.
- When the combined erased pattern is employed, adding random single packet erasures to the random burst pattern, the second dimension copes significantly with the decoding process, whereas the first interleaved dimension is more severely impaired and presents the worst performance.
- When single packets are erased at random, with no burst erasures, both Reed-Solomon schemes present very similar results.

In [10], the combination of random single packets and random bursts is pointed as the most common erasure pattern in IP networks, the first component usually resulting from jitter and buffer overflow, while the second resulting from traffic disruption and network congestion. Thus, we conclude that, even though the single dimensional Reed-Solomon supersedes its two-dimensional version in some erasure patterns, the latter should be a more frequent choice among these two, due to its better results in the more realistic scenario.