**ITU - Telecommunication Standardization Sector** Temporary Document RN-086

STUDY GROUP 15 Original: English

Red Bank, New Jersey, 21 - 25 May 2001

Question: 4/15

SOURCE[1]: VOCAL Technologies Ltd. (http://www.vocal.com)

TITLE: G.gen.bis: G.dmt.bis: G.lite.bis: Impulse noise response of Multi-level Turbo codes vs. Full turbo coding for different interleaver sizes.

**ABSTRACT**

This contribution presents discussion about the use of multi-level and full turbo coding in an Impulse Noise Environment .

## 1. Introduction

This contribution presents discussion about the use of multi-level and full turbo coding in an Impulse Noise Environment .

## 2. Simulation Results

Figure 1 shows the performance of Trellis Code Modulation, Full Turbo Codes with more protection to the parity bits, Full Turbo Codes with parity bits least protected and Multi-level Turbo Codes for a Rate 4/6 64 QAM and for an interleaver size of 5200 (latency < 10 ms).

Figure 2 shows the performance of Trellis Code Modulation, Full Turbo Codes with more protection to the parity bits, Full Turbo Codes with parity bits least protected and Multi-level Turbo Codes for a Rate 4/6 64 QAM and for an interleaver size of 4096 (latency << 10 ms).

Figure 3 shows the performance of Trellis Code Modulation, Full Turbo Codes with more protection to the parity bits, Full Turbo Codes with parity bits least protected and Multi-level Turbo Codes for a Rate 4/6 64 QAM and for an interleaver size of 1088 (latency <<< 10 ms).

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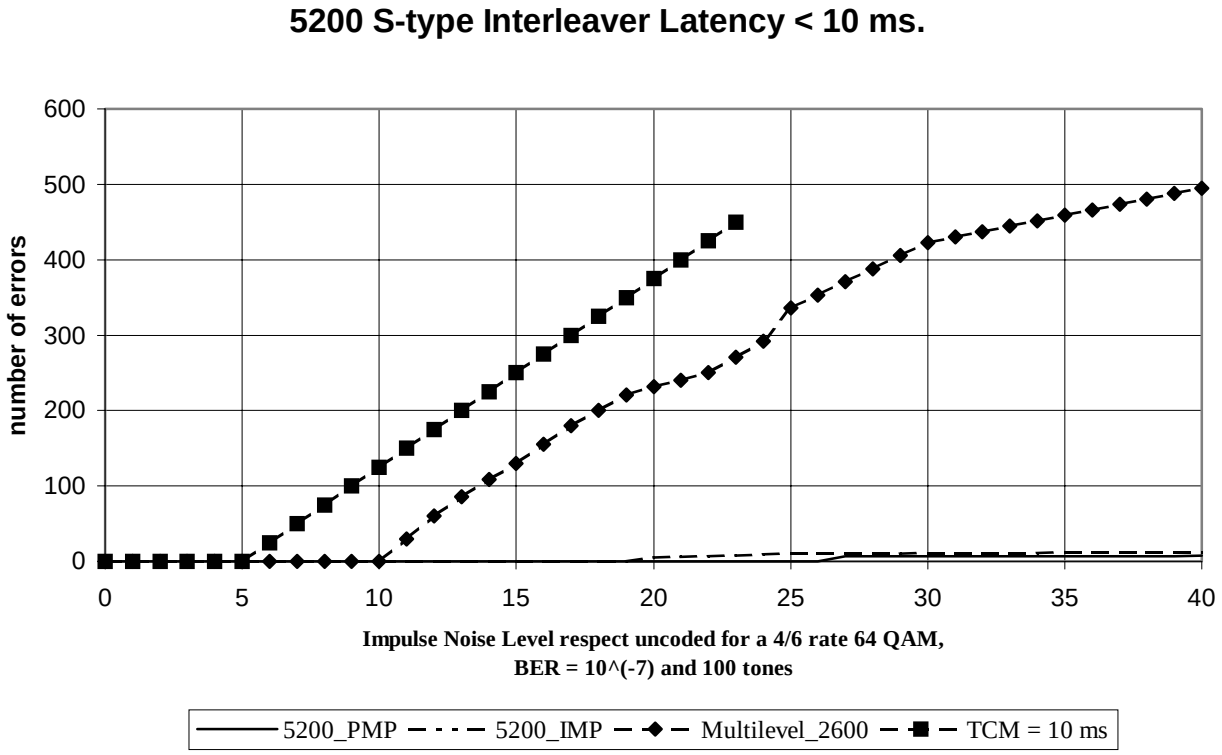


Figure 2. Simulation results in presence of Impulse noise for a rate 4/6 64 QAM and a S-type interleaver size of 5200 (latency < 10 ms)

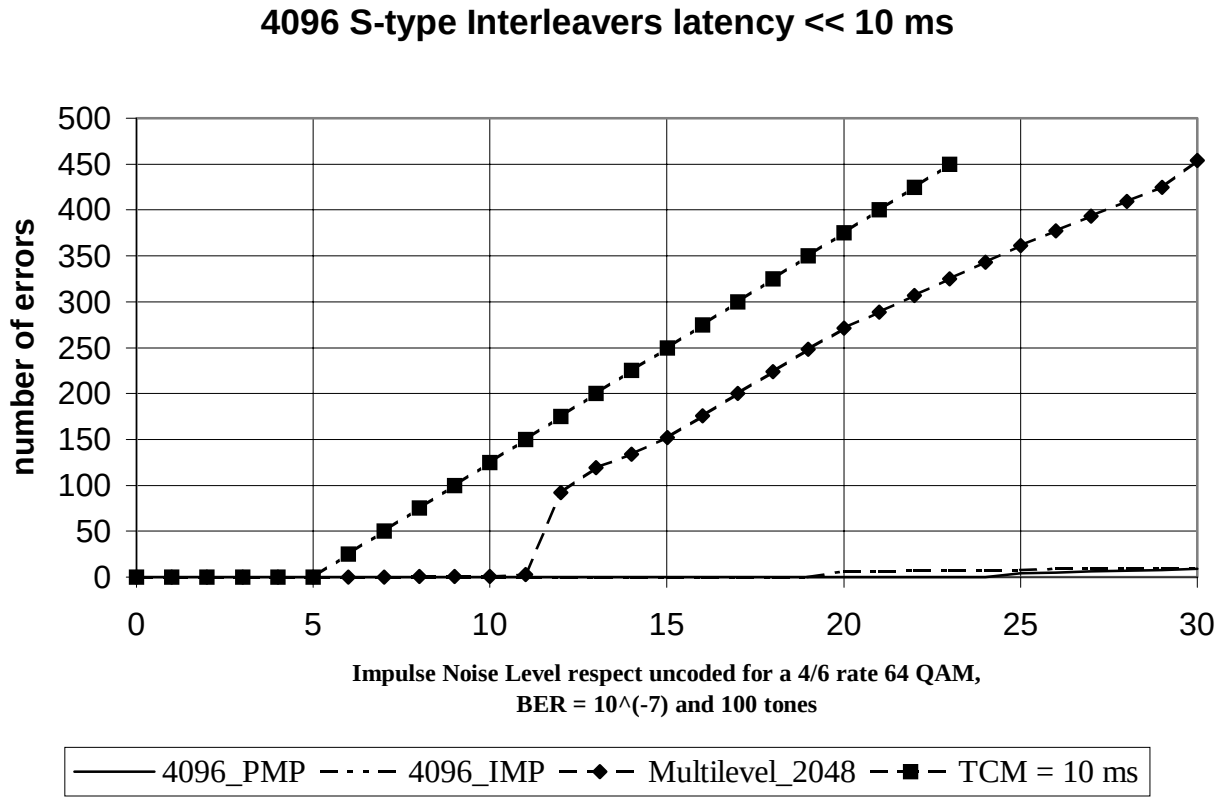


Figure 2. Simulation results in presence of Impulse noise for a rate 4/6 64 QAM and a S-type interleaver size of 4096 (latency << 10 ms)

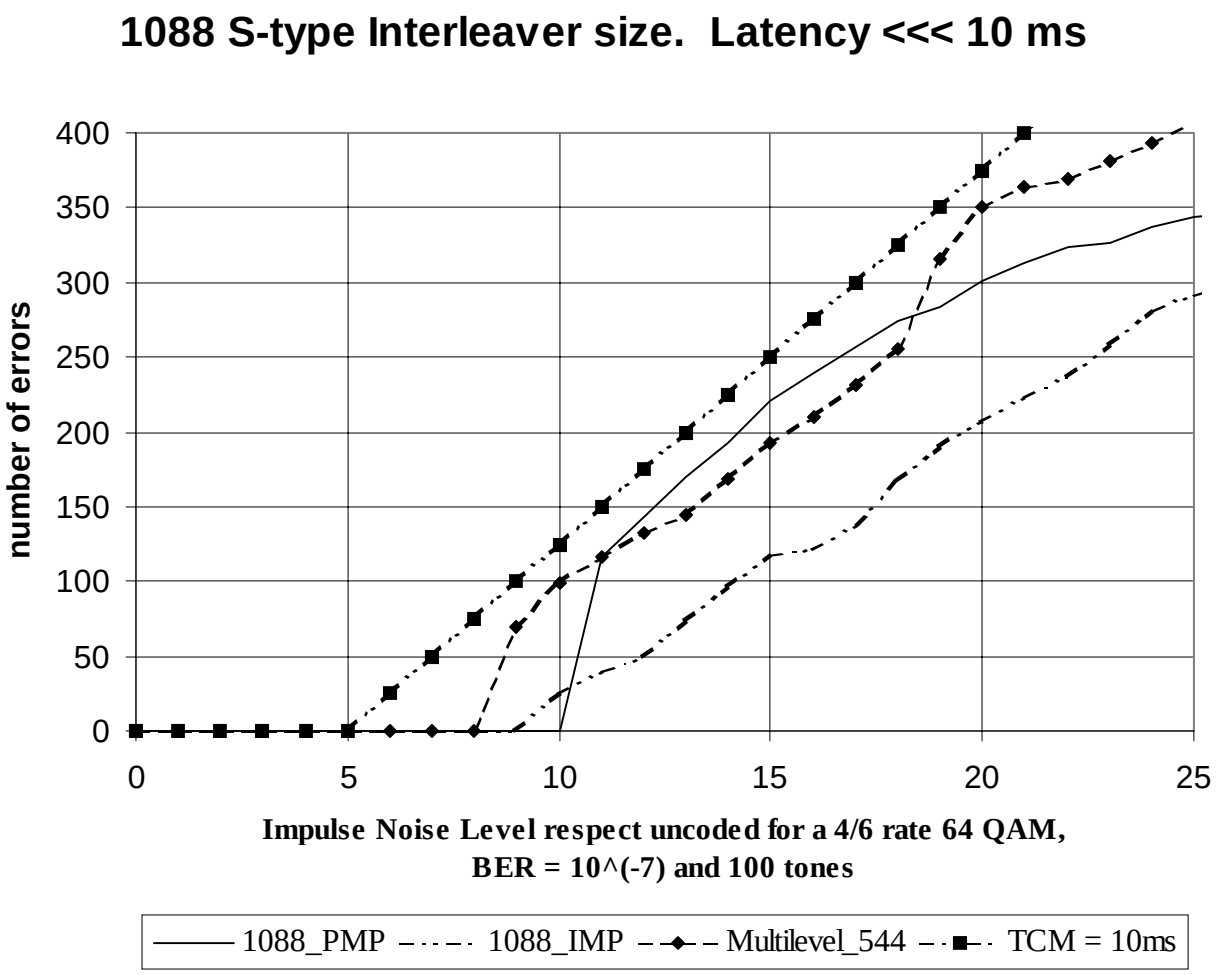


Figure 3. Simulation results in presence of Impulse noise for a rate 4/6 64 QAM and a S-type interleaver size of 1088 (latency <<< 10 ms)

Figure 4 shows the performance of Trellis Code Modulation, Full Turbo Codes with more protection to the parity bits (for 1088 and 31200 S-type interleaver sizes) and Full Turbo Codes with parity bits least protected (for 1088 and 31200 S-type interleaver sizes) for a Rate 12/14 16384 QAM.

If the impulse noise level is very low, the use of TCM is recommended. If the impulse noise is the more important impairment (this usually the more common case) and the application wants to works error free, the full turbo code with more protection to the parity bits may be the best option. If the intention is to have the best performance in all the environments, the Full Turbo Code with more protection to the information bits may be the best option. If the application needs to reduce the computational burden and does not need to work in an Impulse noise environments, the Multi-level Turbo code may be the best option.

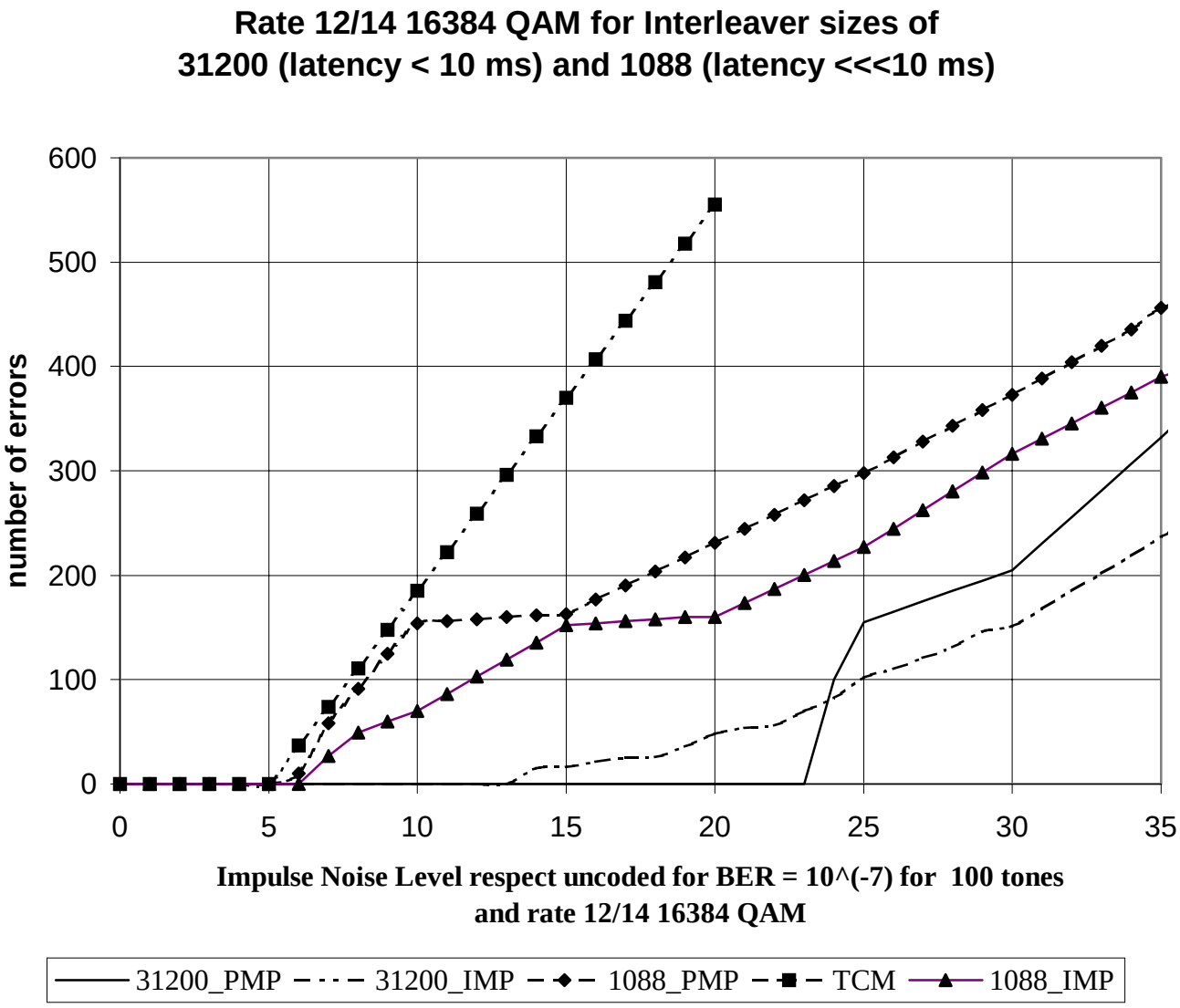


Figure 4. Simulation results in presence of Impulse noise for a rate 12/14 16384 QAM and a S-type interleaver size of 1088 (latency <<< 10 ms) and 31200 (latency < 10 ms)

## 3. Summary

The present paper relates to a technique for implementation of Turbo Code for DSL modems. Taken into account the benefits of Turbo Codes for DSL modems it is recommend to include a configurable Turbo Codes such as the one defined in RN-xx6 in the next DSL's ITU Recommendations.

1. Agenda Item: G.992.1.bis issue 4.6 and G.992.2.bis issue 10.14.
2. Expectations: The committee accepts the inclusion of Turbo codes for G.992.1.bis, G.992.2.bis.