Speech Property-Based FEC for Internet Telephony Applications

Nguyen Tuong Long Le and Henning Sanneck

GMD FOKUS, Berlin

www.fokus.gmd.de/glone

{le,sanneck}@fokus.gmd.de

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Overview

- Voice over IP (VoIP)
  - Improved quality for VoIP
- Approach
  - Performance of the G.729 loss concealment
  - Speech Property-Based FEC (SPB-FEC)
- Evaluation
  - Reference FEC schemes
  - Network model
  - Objective speech quality measurement
- Conclusions

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Voice over IP

- Main drivers:
  - current economical incentives (Internet flat rate pricing) ➢ *Internet Telephony*
  - service integration, unified packet-switching infrastructure
- One of the main problems:
  - satisfaction of real-time QoS demands in a packet-switched network (fundamental tradeoff: statistical multiplexing vs. reliability ➢ *packet loss*)

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QoS for Voice over IP flows

– high compression (backward adaptive coding: ITU-T G.729, G.723.1)
  - no further sender adaptation / network adaptation (transcoding) possible
  - amplifies high perceptual impact of burst losses (error propagation)

+ tolerance to isolated losses (speech stationarity ⩾ extrapolation of coder state ⩾ loss concealment)

⩾ enhance the loss resiliency of high-compressing codecs with open-loop error control (FEC)

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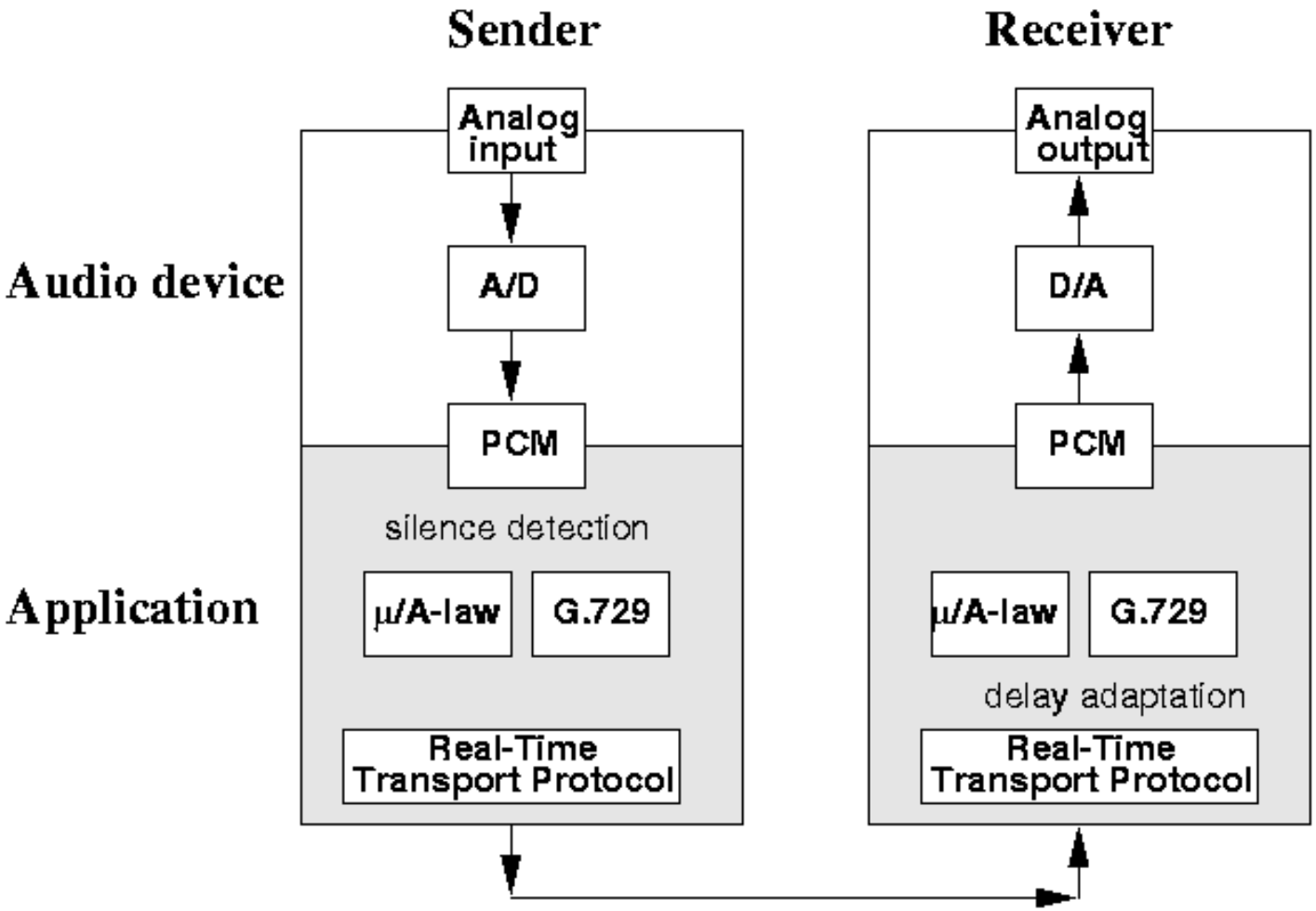
Structure of an Internet Audio Tool



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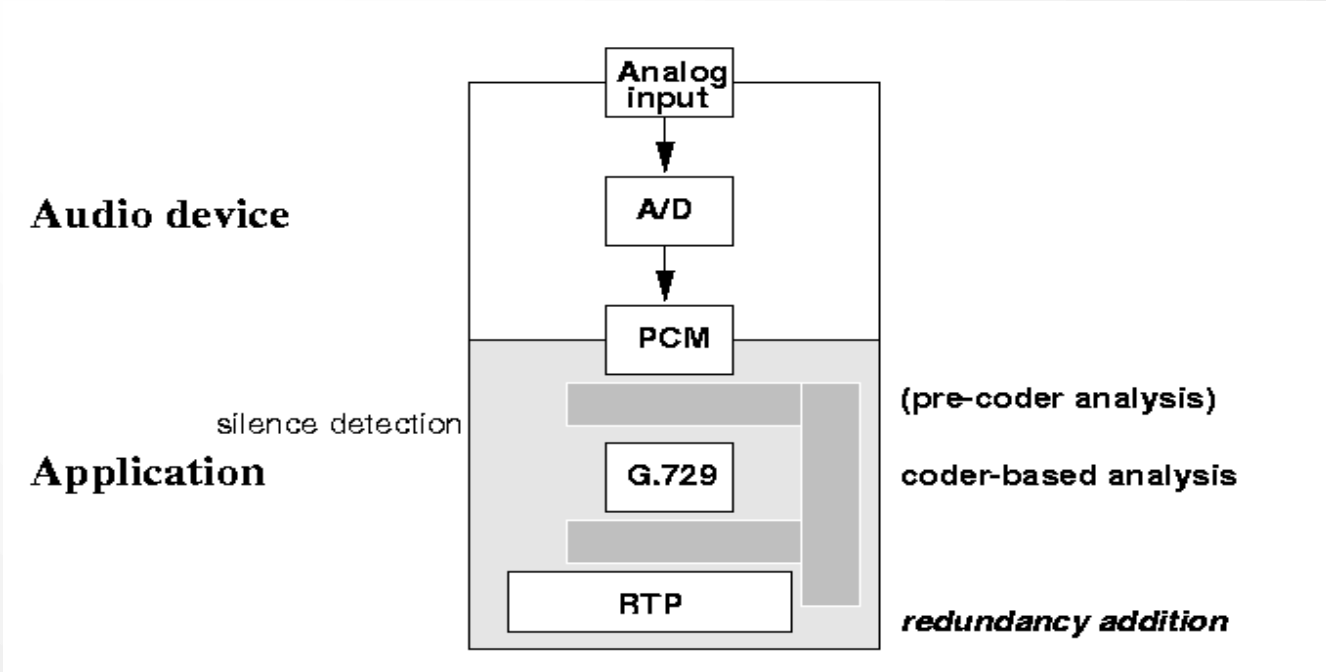
Additional components: Sender



- G.729 coder used both for the payload and the redundancy
- Side information available at the encoder is used
- Decoder concealment process is taken into account

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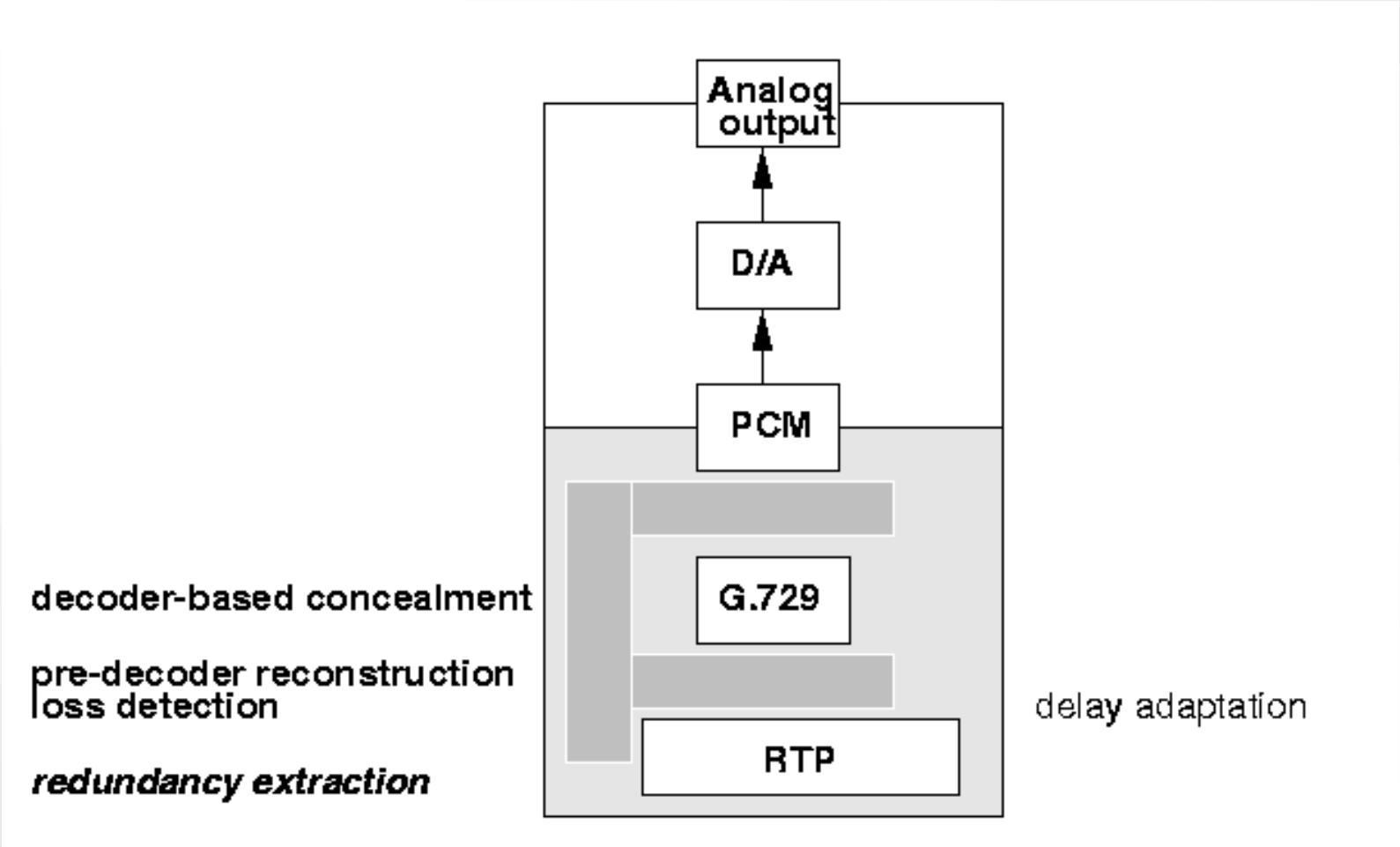
Additional components: Receiver



- No generic (PCM-level) concealment

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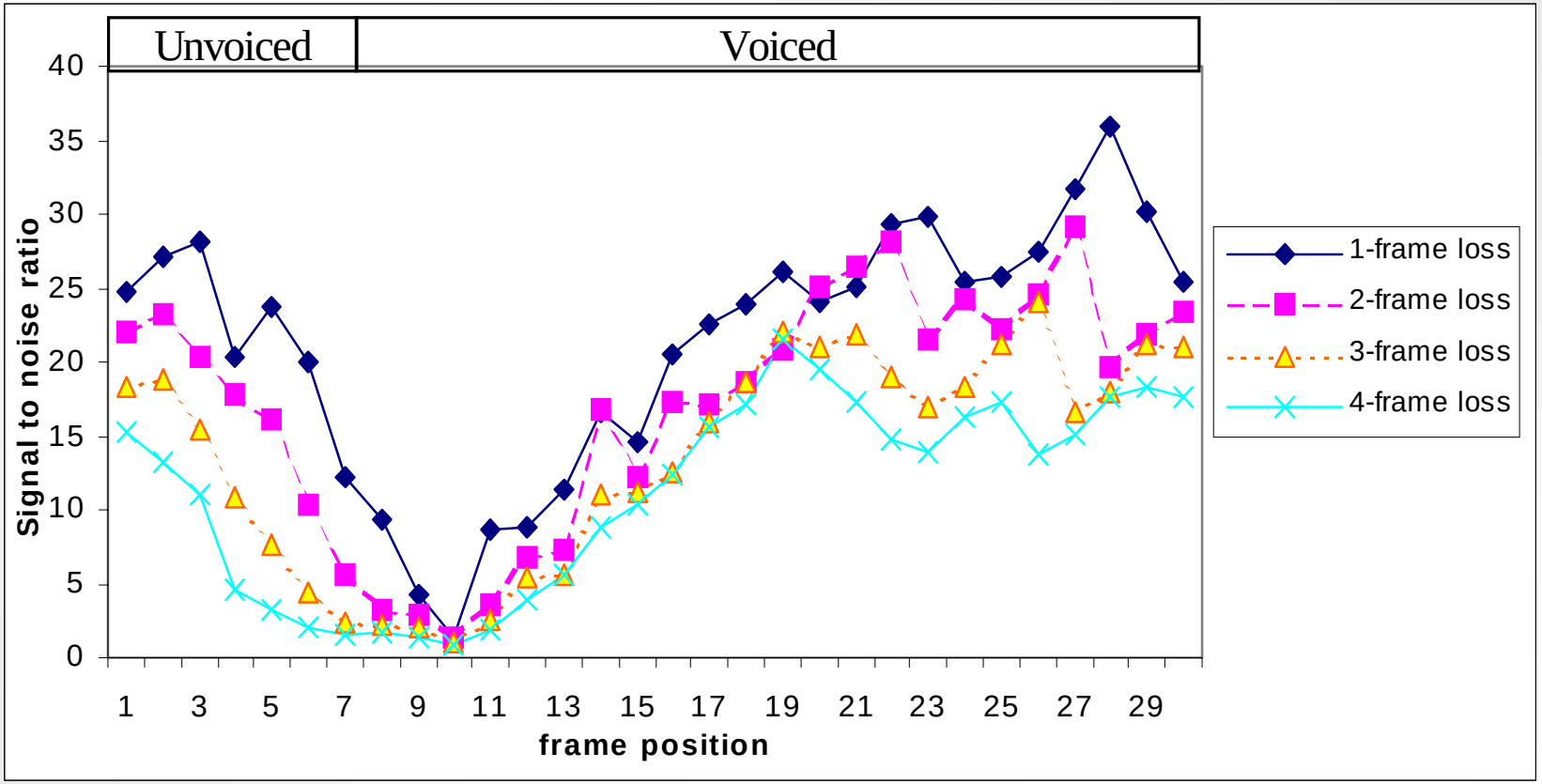
Performance of G.729 loss concealment



- Decoder fails to conceal losses at unvoiced/ voiced transition due to lack of state (synthesis filter parameters, excitation)

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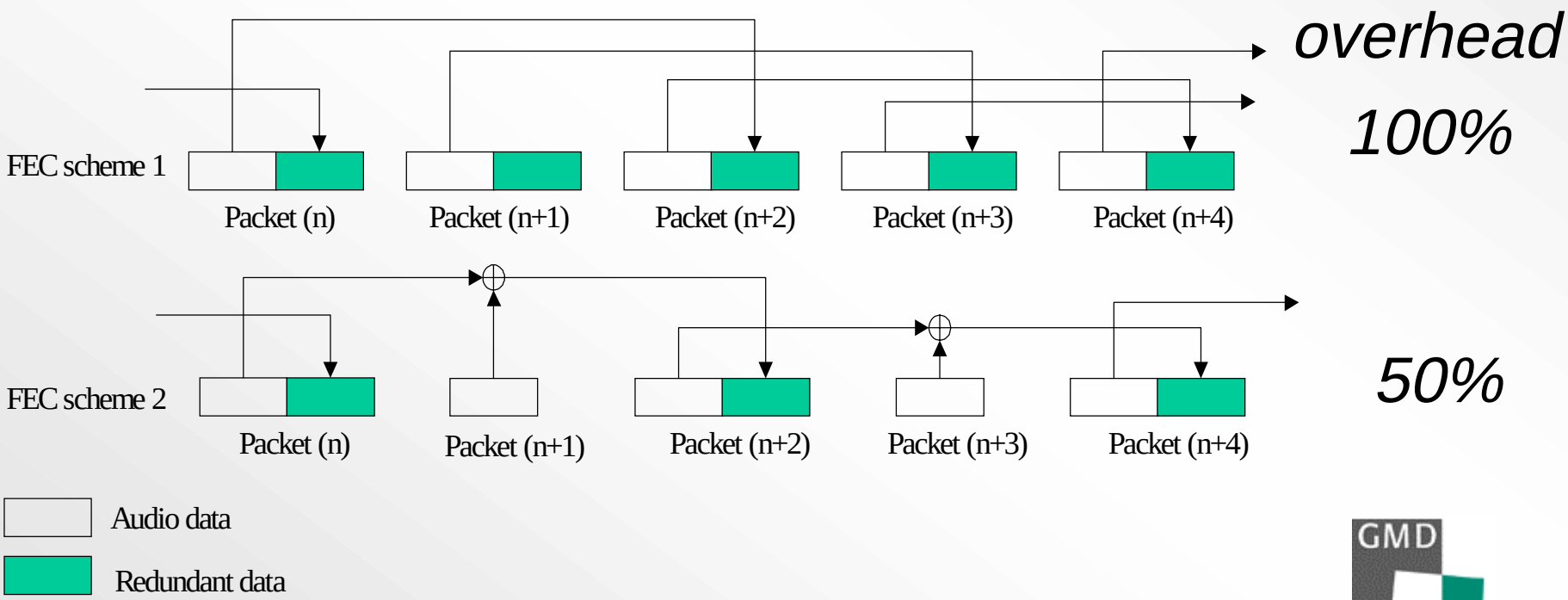
Speech Property-Based FEC

- Adjust amount of redundancy adaptively to loss concealment performance: *overhead ≈ 40-50%*
- Comparison with two reference FEC schemes



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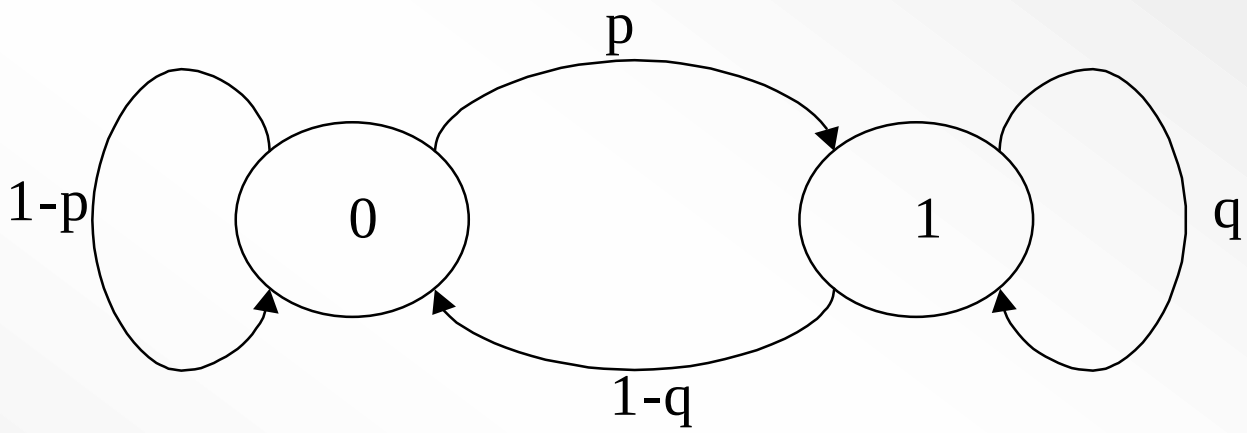
Network Model



Network loss condition 1	Network loss condition 2	Network loss condition 3	Network loss condition 4	Network loss condition 5
p=0.05, q=0.2	p=0.1, q=0.3	p=0.15, q=0.4	p=0.2, q=0.5	p=0.25, q=0.6

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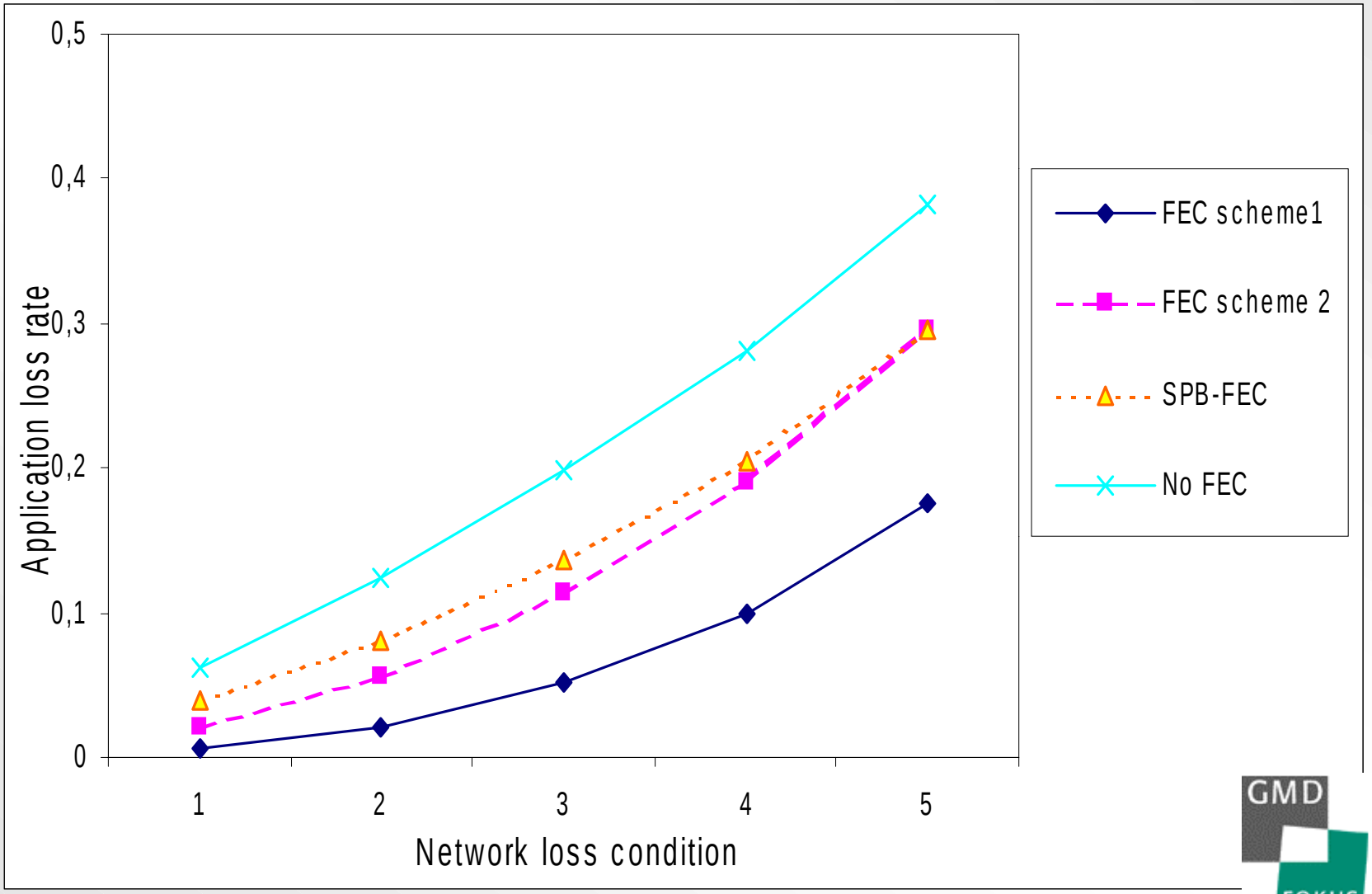
Results: Application-level loss rate



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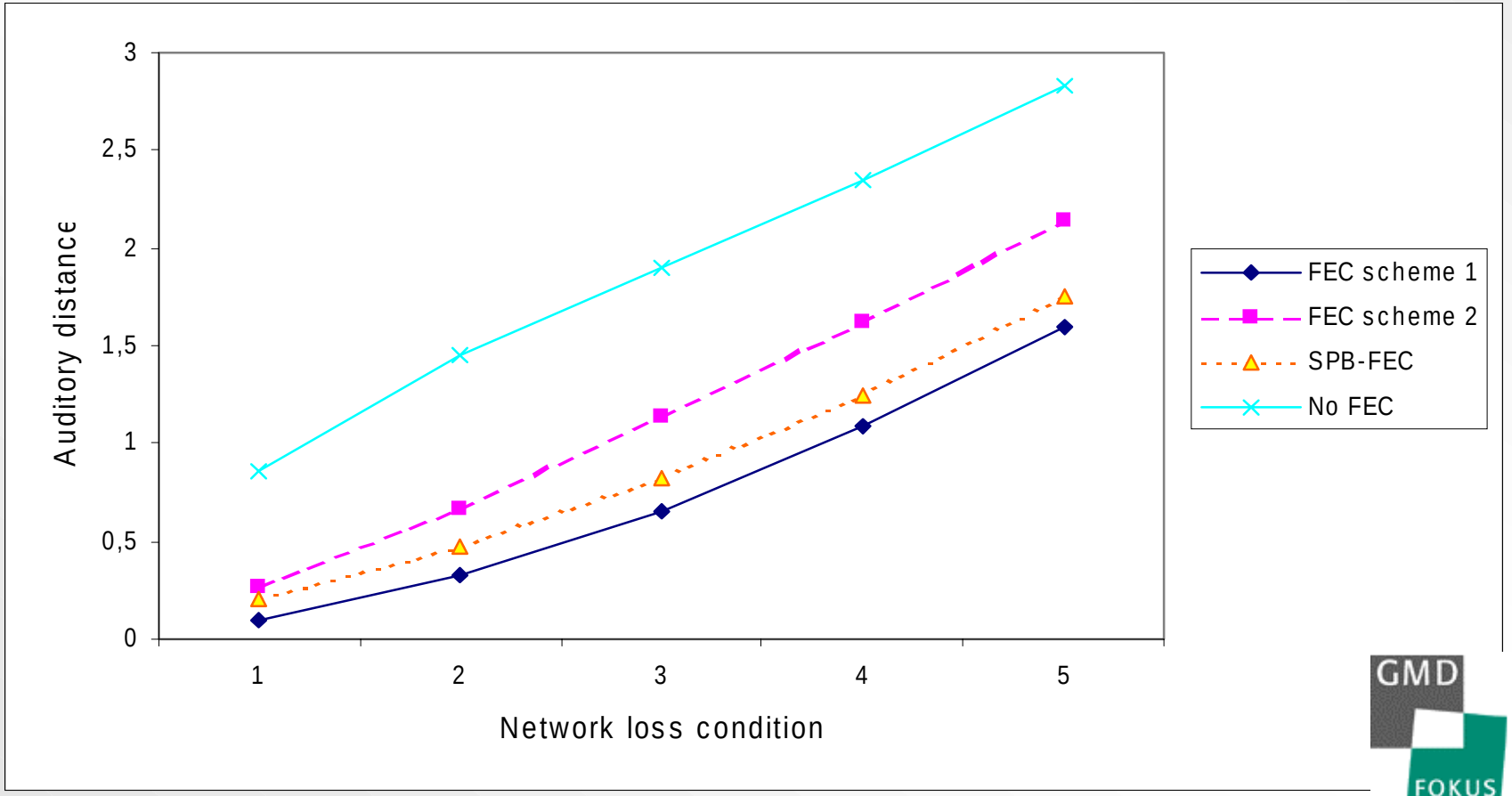
Results: Auditory Distance

- Application of recent advances in objective speech quality measurement: ITU P.861A



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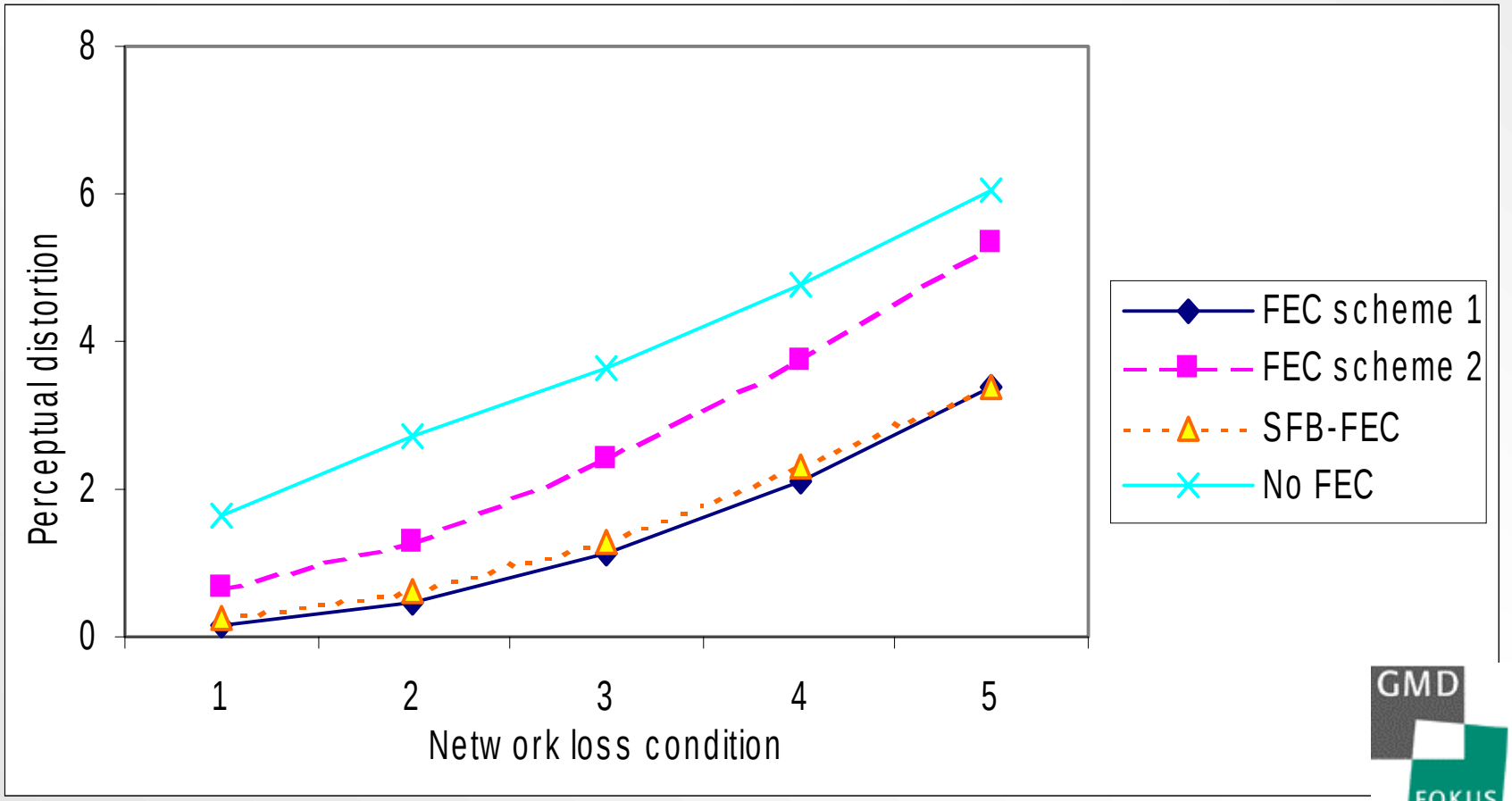
Results: Perceptual Distortion

- Enhanced Modified Bark Spectral Distortion (EMBSD; Temple University)



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Conclusions

- SPB-FEC exploits differences in „concealability“ to adjust the amount of added redundancy
- simple network model & objective speech quality measures showed the reduction of necessary redundancy to maintain a good output quality
- Speech samples:
  - www.fokus.gmd.de/glone/products/voice/spb-fec
- end-to-end operation: add network adaptivity
- mapping to network prioritization (DiffServ)

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