DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING

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Embedded CELP Voice Coding

Summary:

We modified an existing voice coder (QCELP) to embed speech at rates lower than its maximum rate by simply dropping packets of bits. When the number of calls reaches capacity, the network will refuse additional users. However, using our coder, a network can handle overload by gracefully degrading the quality of speech.

Methodology:

•Use of multi-stage vector quantization for codebooks.

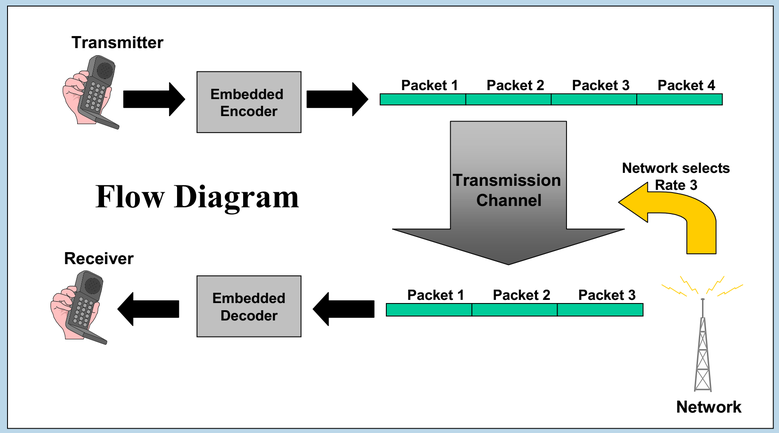
•Modification of the size of QCELP's subframes for pitch parameters.

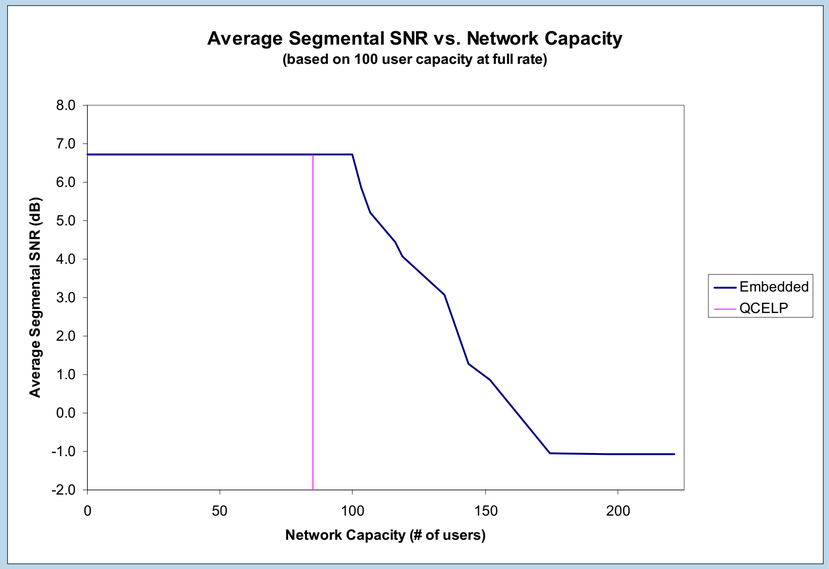
•Judicious choice of bit allocation at each introduced rate between different sets of parameters.

Key Results:

•The embedded coder matches the quality of the QCELP coder when compared at the same rate.

•The embedded coder offers several lower rates that are directly extracted from the high rate bit stream of the encoder.





Coder Comparison:

Coder Type	Characteristics	Advantages	Disadvantages
Basic CELP	• Uses the correlation of human speech to compress the speech signal. • Transmits parameters to speech synthesis filters instead of the speech waveform itself.	• Reduces the amount of information to transmit.	• Limited to a fixed rate. • Network has no control over rate. • Requires all the encoded information to be transmitted.
Variable Rate (QCELP)	• Encodes speech at several fixed rates, depending on the speech segment energy.	• Saves bandwidth by decreasing the average encoding rate.	• Limited to a fixed average rate. • Network has no control over rate. • Requires all the encoded information to be transmitted.
Embedded, Variable Rate	• Encodes speech at several fixed rates, like QCELP. • Embeds lower rate speech signals in the high rate bit stream.	• Encodes speech at the highest rate it needs, ignoring network usage. • Allows the transmission of a lower rate if the network reaches capacity.	• None.

Conclusion:

With a fixed or variable rate coder, wireless systems reach a point where additional calls cannot be admitted. However, with an embedded coder, wireless systems can increase system capacity through a tradeoff with average speech quality, even when the system uses all its available bandwidth.

Further Work:

Create a network simulation environment to better quantify the tradeoff between network capacity and average speech quality.