TOWARDS FASTER END-TO-END DATA TRANSMISSION OVER VOICE CHANNELS

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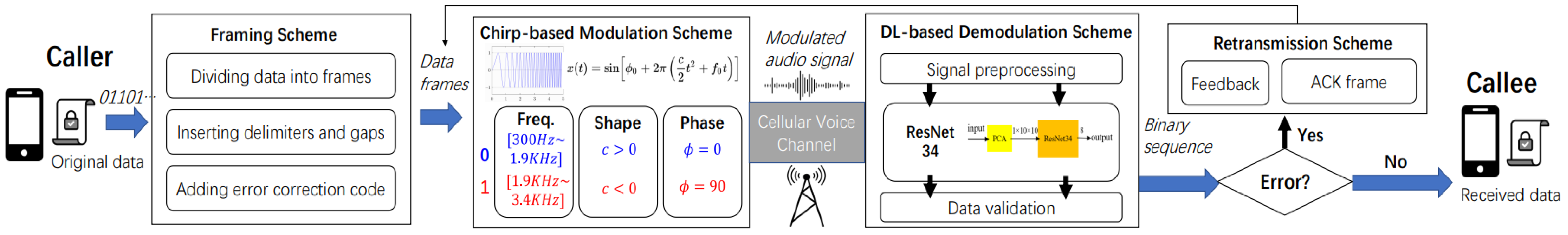


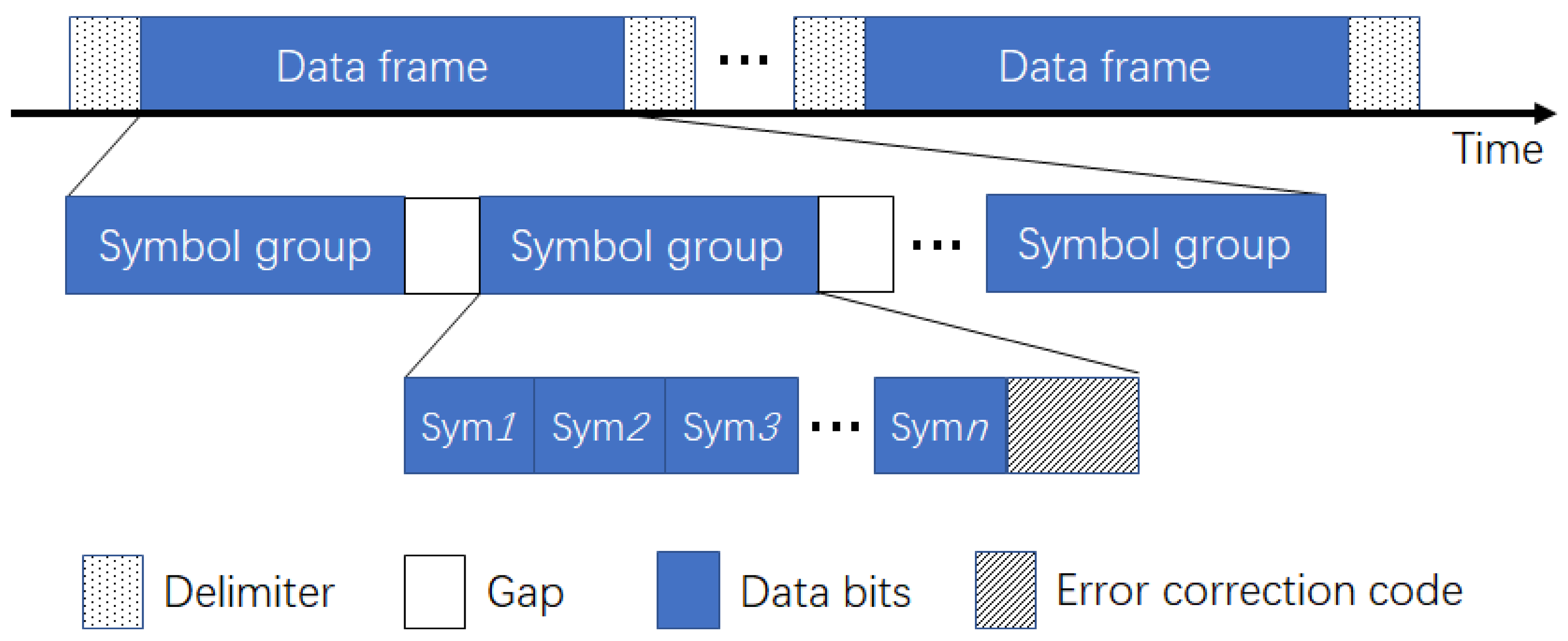
Framing Scheme

Delimiter: A unique chirp which ensures the synchronization between the receiver and transmitter

Symbol: Each symbol carries a fixed length of data bits.

Gap: An empty signal after a group of symbols, which is designed to avoid the impact of voice activity detection (VAD).

Error correction code: Reed-Solomon codes



Chirp-based Modulation Scheme

We modulate 3-bit information by varying the frequency, shape, and phase of our chirp signal.

Frequency.
we use f_0 = 300Hz and f_0 = 1.9KHz to encode bits 0 and 1.

$$\begin{cases} b = 0, f_0 = 0.3KHz \\ b = 1, f_0 = 1.9KHz \end{cases}$$

Shape.
The chirp with 300Hz → 1.9KHz represents the bit 0, and 1.9KHz → 300Hz for the bit 1.

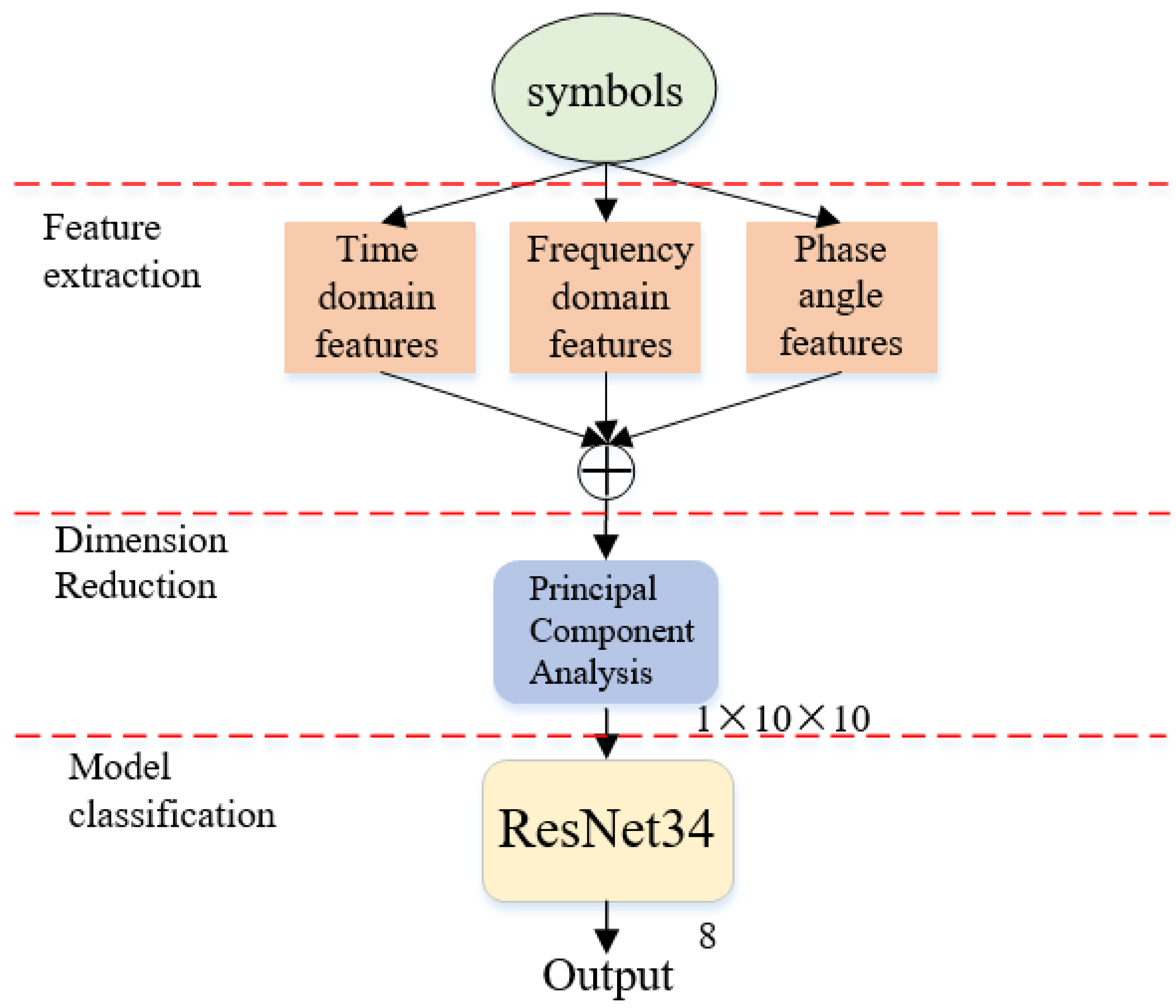
$$\begin{cases} b = 0, c > 0 \\ b = 1, c < 0 \end{cases}$$

Phase.
Whether the signal carries 0 or 1 depends on whether the initial phase ϕ_0 equals zero.

$$\begin{cases} b = 0, \phi_0 = 0 \\ b = 1, \phi_0 \neq 0 \end{cases}$$

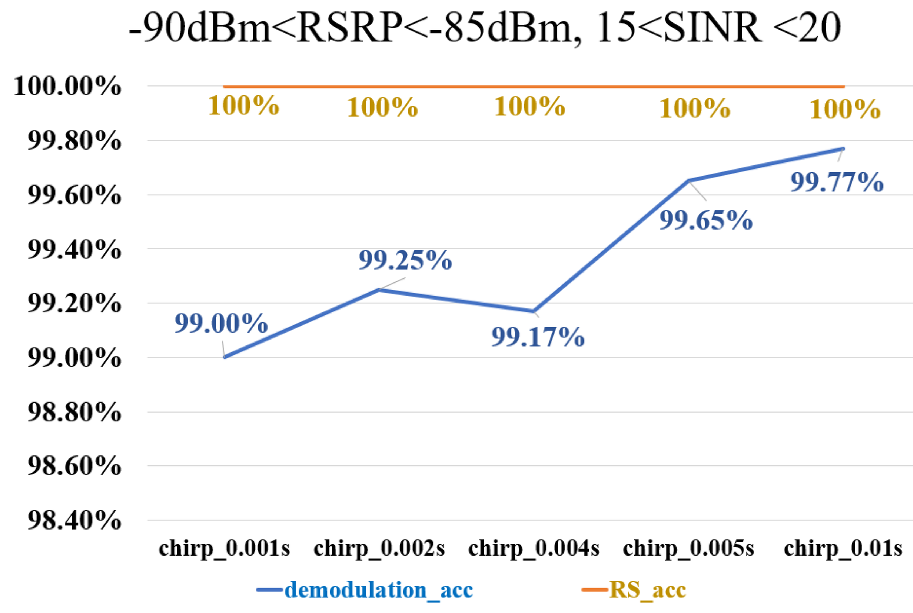
DL-based Demodulation Scheme

We use DL models to demodulate the received signals

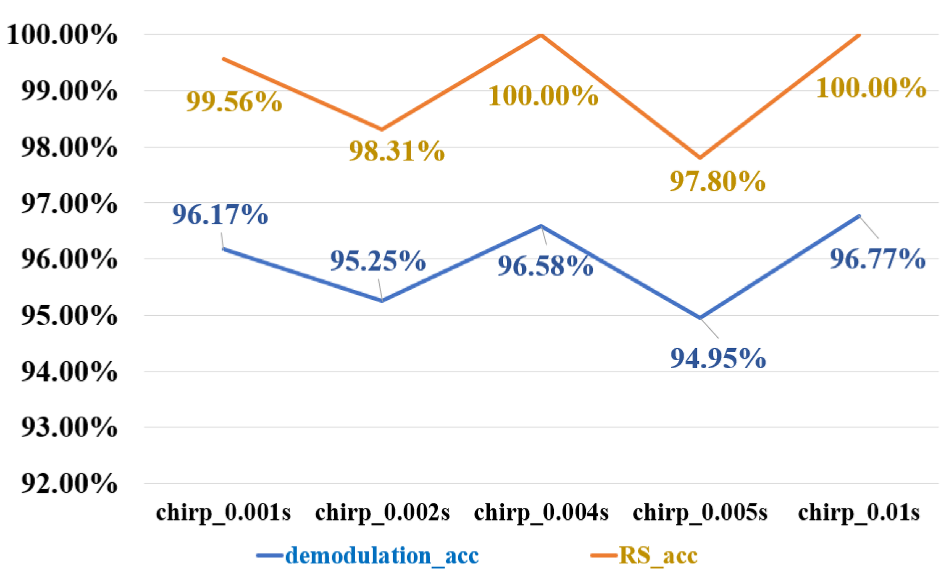


Result

-90dBm<RSRP<-85dBm, 15<SINR <20



-100dBm< RSRP <-90dBm,11< SINR <15



Throughput and goodput under different symbol lengths (bit/s)

Symbol length	**0.001s**	0.002s	0.003s	0.004s	0.005s	0.01s
Throughput	**1785.12**	853.75	427.72	347.83	347.83	173.49
Goodput(Strong)	**1338.84**	640.32	320.79	260.87	260.87	130.12
Goodput(Medium)	**1332.95**	629.50	320.79	255.13	255.13	130.12
Goodput(Weak)	**1201.34**	568.67	291.85	223.15	223.15	115.79

The demodulation scheme achieves very high accuracy (> 94%, the blue line) and demonstrates almost perfect performance when additionally using error correction design (> 97% , the red line).

Our design achieves excellent goodput, 1291.0 bit/s goodput on average,1338.84 bit/s when the signal is strong, and 1201.34 bit/s even when the signal is weak.