5. By WLLN, for sufficiently large n,

$$\begin{aligned}
&\Pr\{E_e|W=1\} \\
&= \Pr\left\{\frac{1}{n}\sum_{i=1}^{n}\kappa(\tilde{X}_i(1)) > P \,\middle|\, W=1\right\} \\
&= \Pr\left\{\frac{1}{n}\sum_{i=1}^{n}\kappa(\tilde{X}_i(1)) > P\right\} \\
&= \Pr\left\{\frac{1}{n}\sum_{i=1}^{n}\kappa(\tilde{X}_i(1)) > (P-\gamma)+\gamma\right\} \\
&\leq \Pr\left\{\frac{1}{n}\sum_{i=1}^{n}\kappa(\tilde{X}_i(1)) > E\kappa(X)+\gamma\right\} \\
&\leq \frac{\epsilon}{4}.
\end{aligned}$$

6. Therefore,

$$\Pr\{Err\} \leq \frac{\epsilon}{2}$$

which implies for some codebook $\mathcal{C}^*$,

$$\Pr\{Err|\mathcal{C}^*\} \leq \frac{\epsilon}{2}.$$

7. Rank the codewords in $\mathcal{C}^*$ in ascending order according to $\Pr\{Err|\mathcal{C}^*, W=w\}$.

8. After discarding the worst half of the codewords in $\mathcal{C}^*$, if a codeword $\tilde{\mathbf{X}}(w)$ remains in $\mathcal{C}^*$, then

$$\Pr\{Err|\mathcal{C}^*, W=w\} \leq \epsilon.$$

9. However, it is not clear whether $\tilde{\mathbf{X}}(w)$ satisfies both $\lambda_w \leq \epsilon$ and the input constraint.

10. Since $Err = E_e \cup E_d$, we have

$$\lambda_w = \Pr\{E_d|\mathcal{C}^*, W=w\} \leq \epsilon$$

and

$$\Pr\{E_e|\mathcal{C}^*, W=w\} \leq \epsilon.$$

11. Observe that conditioning on $\{\mathcal{C}^*, W=w\}$, the codeword $\tilde{\mathbf{X}}(w)$ is deterministic, so either

$$\Pr\{E_e|\mathcal{C}^*, W=w\} = 0$$

or

$$\Pr\{E_e|\mathcal{C}^*, W=w\} = 1.$$

Therefore, $\Pr\{E_e|\mathcal{C}^*, W=w\} = 0$.