$$(v_i, e_k) \qquad (v_i', e_k') \qquad (v_i'', e_k'') \qquad (e_k''') \qquad (e_k''')$$

$$\begin{aligned}
\mathbf{e}_{k}' &= \phi_{1}^{e}(\mathbf{e}_{k}) & \mathbf{e}_{k}'' &= \phi_{2}^{e}(\mathbf{e}_{k}', \mathbf{v}_{r_{k}}', \mathbf{v}_{s_{k}}') \\
\mathbf{v}_{i}' &= \phi_{1}^{v}(\mathbf{v}_{i}) & \mathbf{\bar{e}}_{i}'' &= \rho^{e \to v}(E_{i}')
\end{aligned}$$

$$\mathbf{v}_{i}'' &= \phi_{2}^{v}(\mathbf{\bar{e}}_{i}'', \mathbf{v}_{i}') & \mathbf{e}_{k}''' &= \phi_{3}^{e}(\mathbf{e}_{k}'')$$