

# Mutation Pathway Aggregation Strategy

Total pathway genes: 26

Mutation thresholds:  
3% general genes  
1% bladder cancer genes

*Biologically meaningful grouping reduces dimensionality while preserving signal*

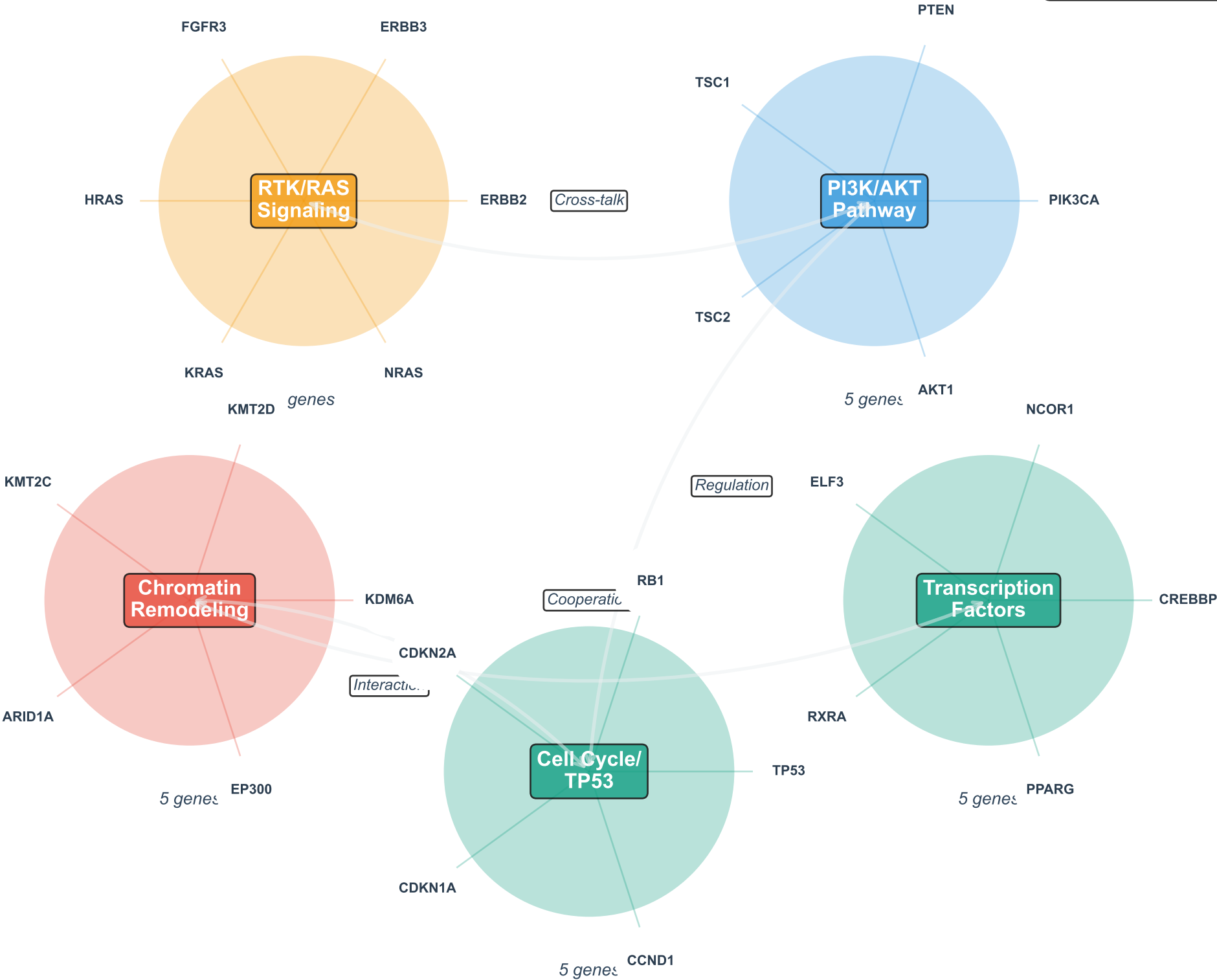


Figure 7. Mutation pathway aggregation network. Individual gene mutations are grouped into functional pathways (e.g., RTK-RAS, PI3K-AKT) to reduce dimensionality from 1,725 to 5 pathway features while preserving biological signal.