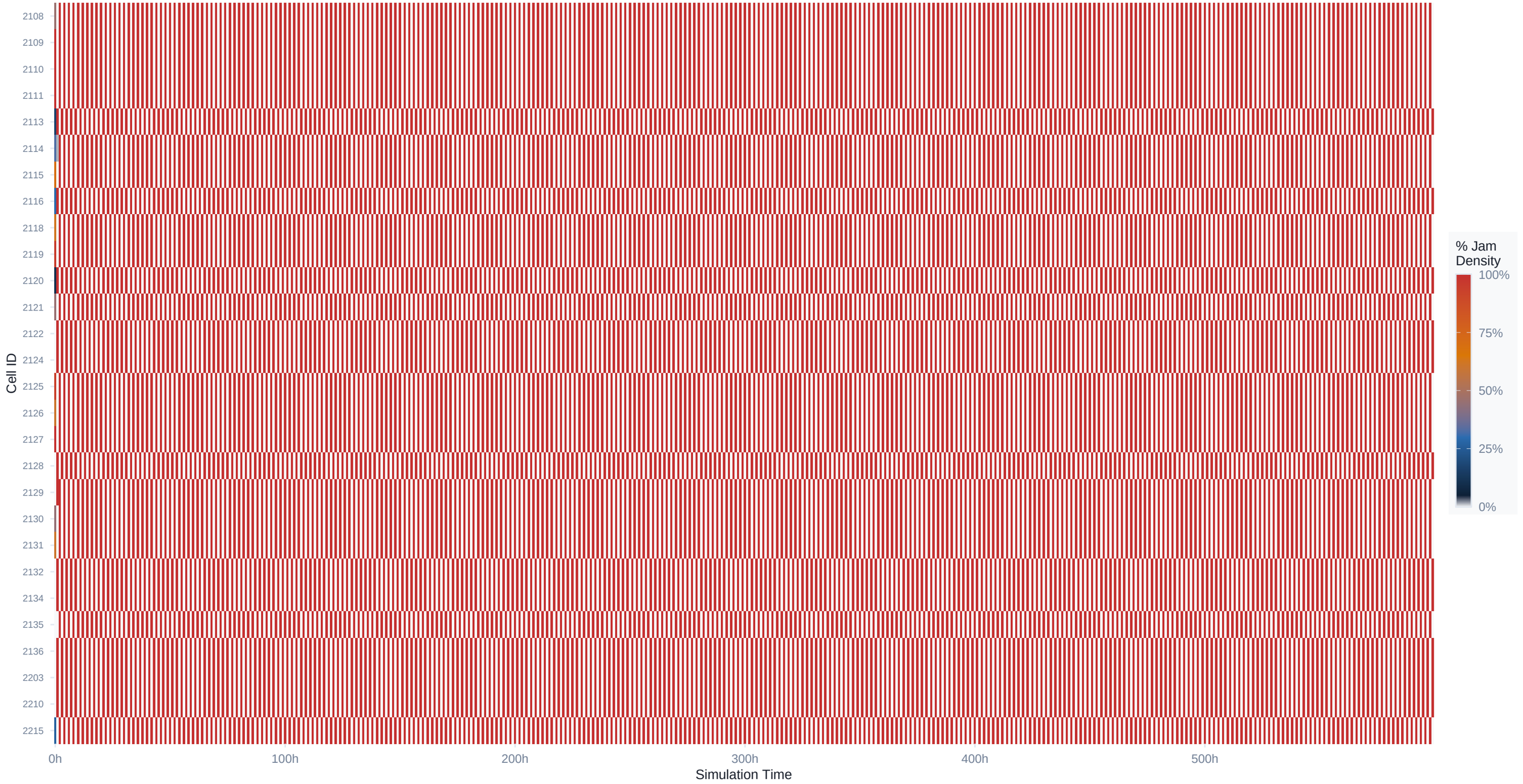
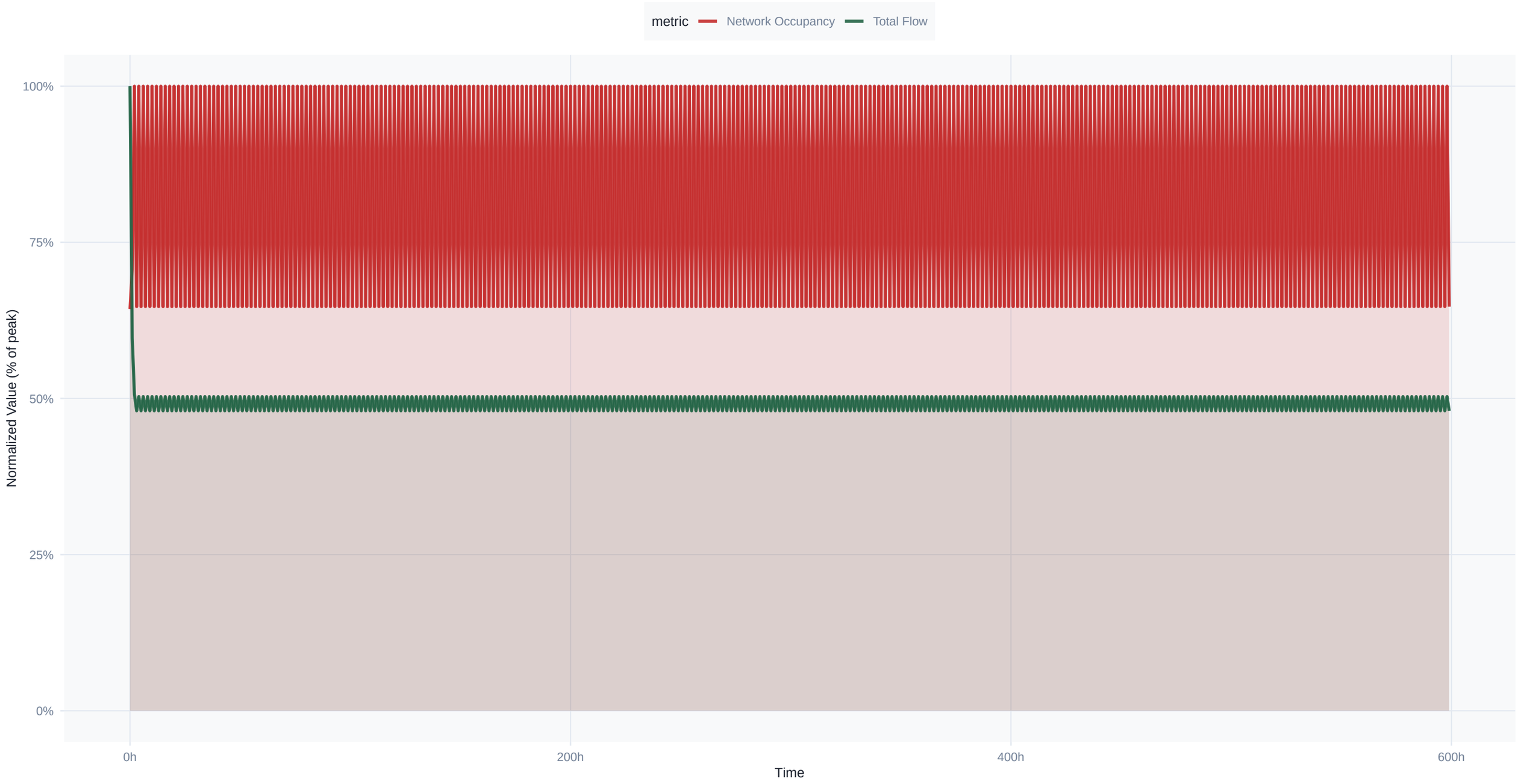
Space–Time Congestion Map

Each row = one cell · color = % of jam density · dark = free−flow · red = gridlock



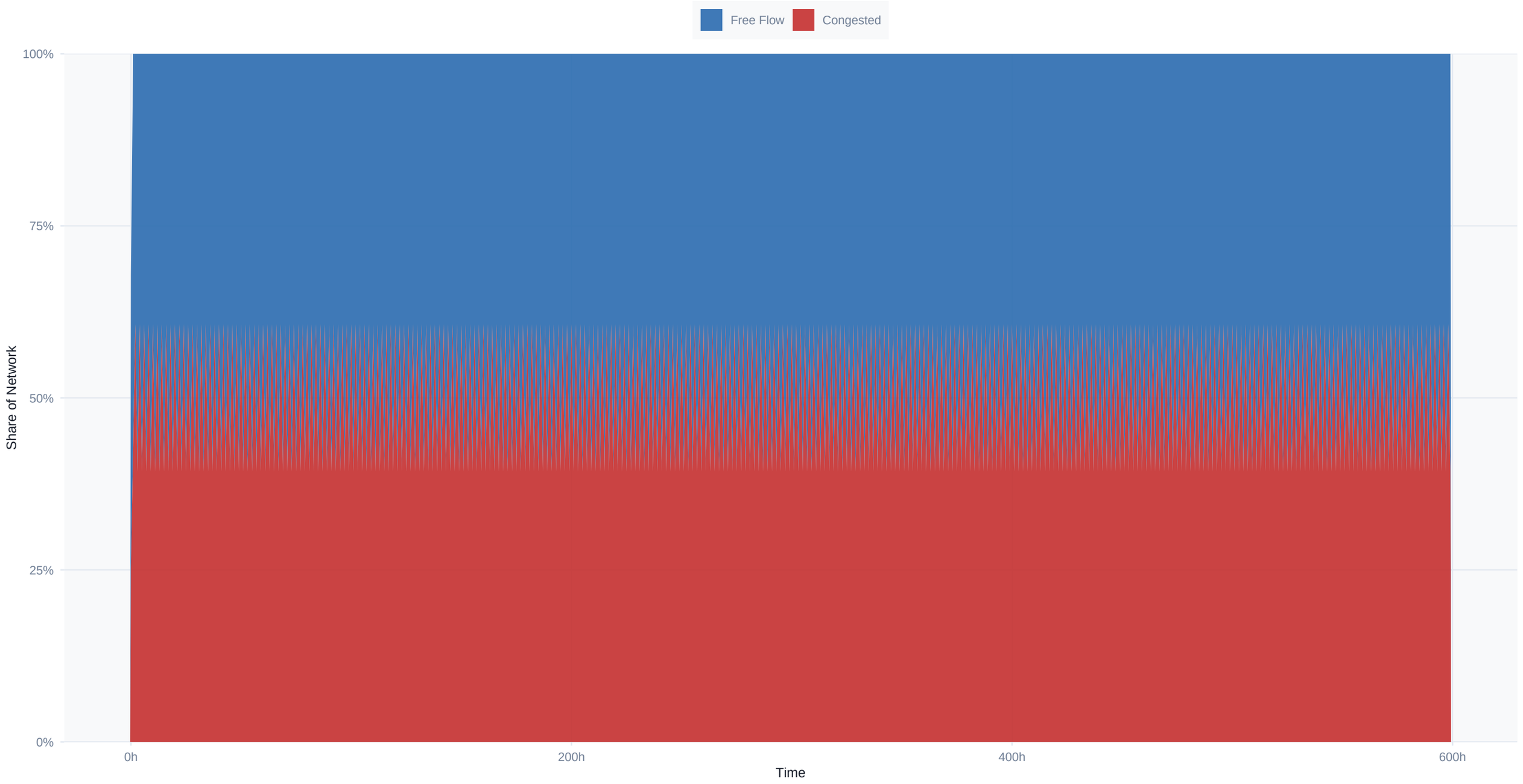
Network Pulse

Normalized occupancy vs. flow — divergence signals bottleneck formation



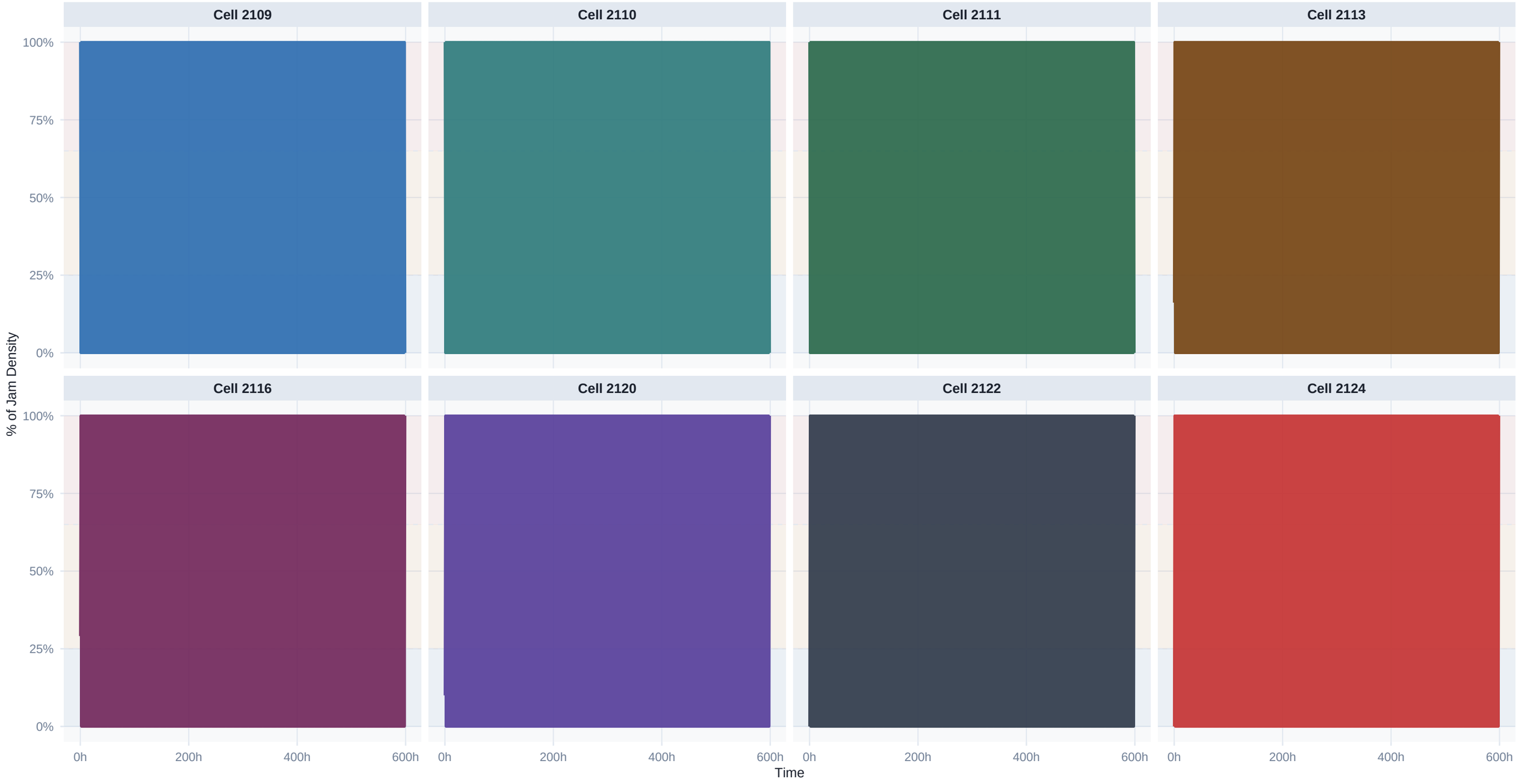
Network State Composition Over Time

Share of cells in each congestion regime at each timestep



Congestion Trajectory — Top Busiest Cells

% of jam density over time · shaded bands = free/transitional/congested regimes

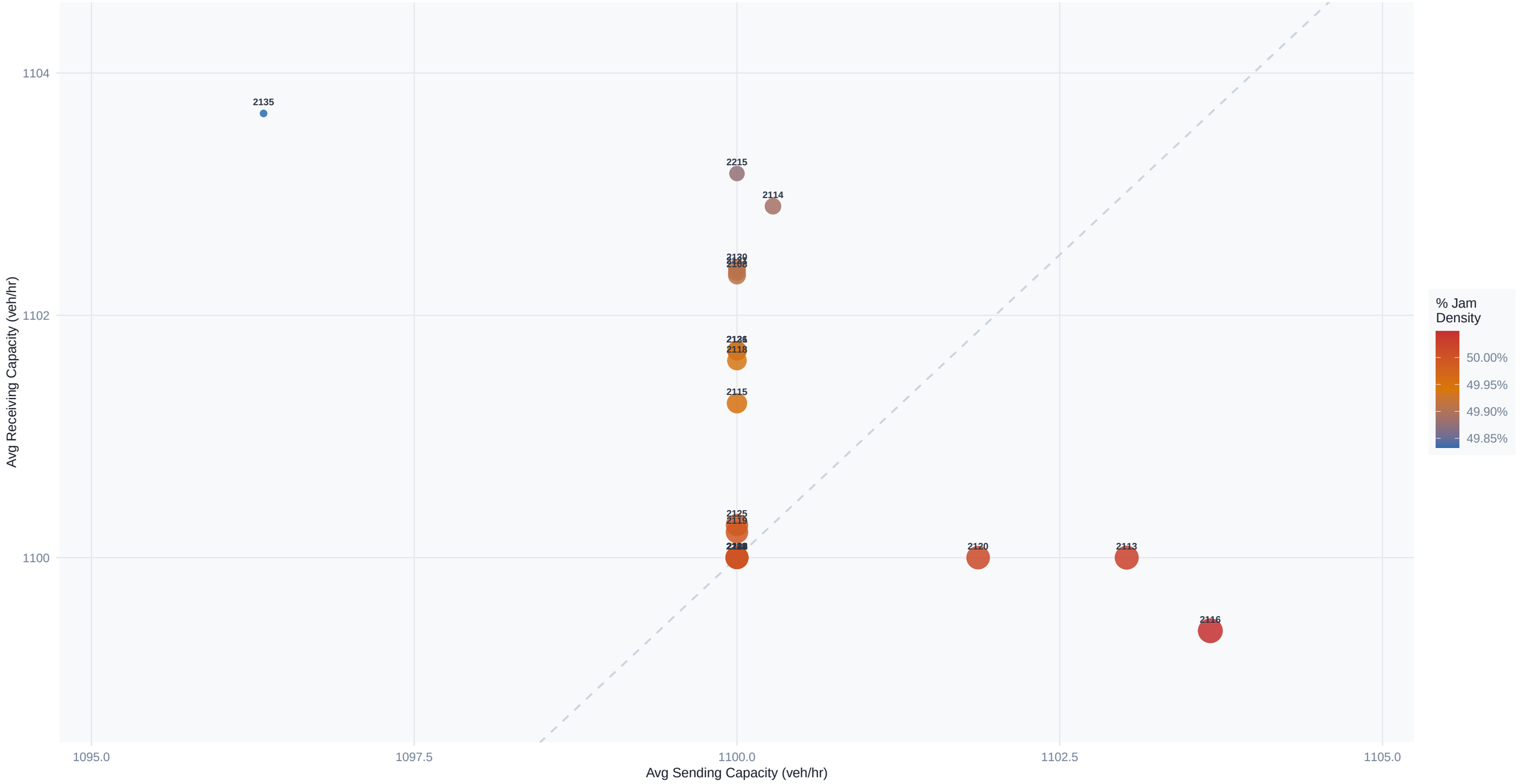


Density Distribution by Cell

Spread of occupancy states across simulation — color = chronic congestion level

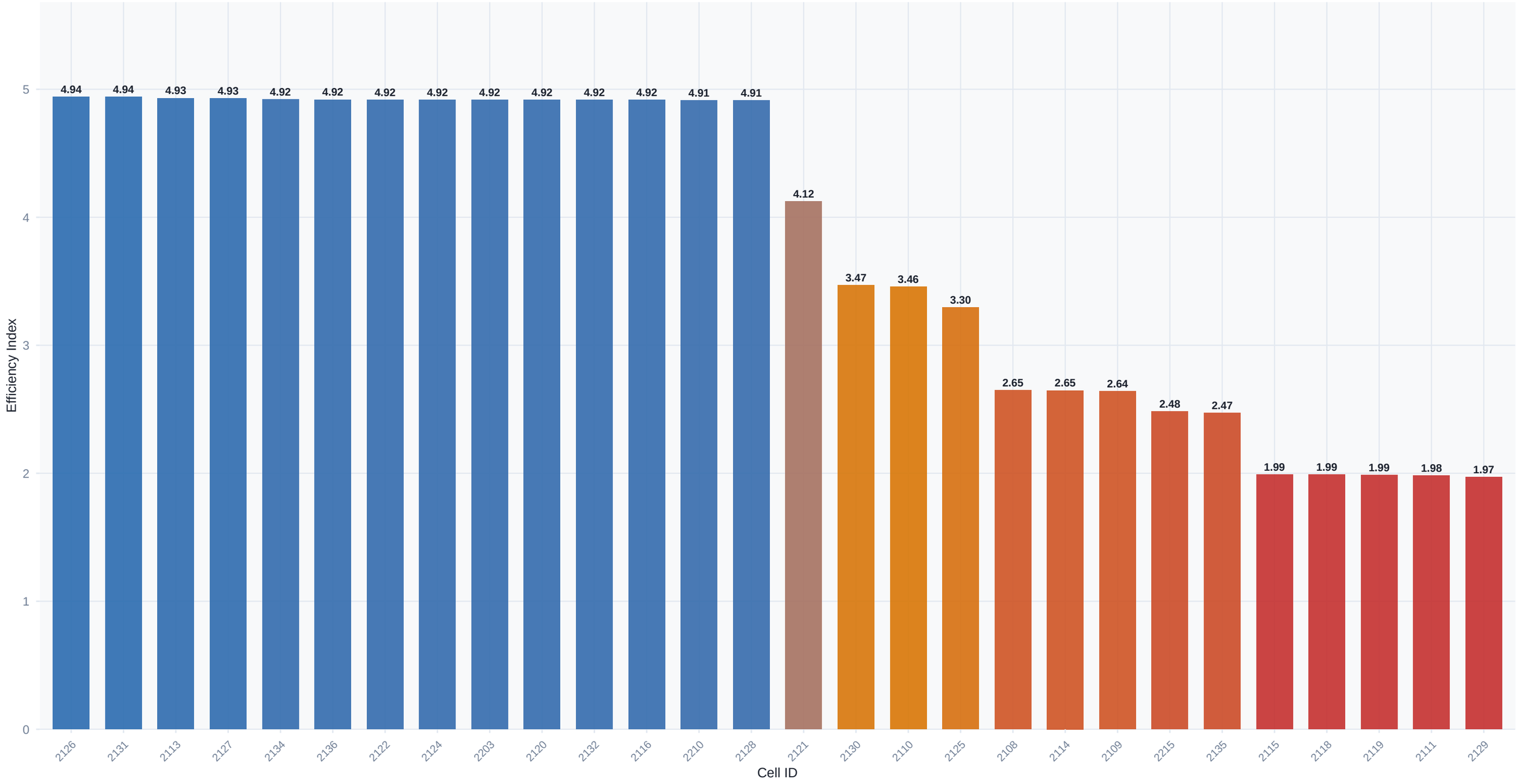
Sending vs. Receiving Capacity

Points below diagonal = bottlenecks · color = congestion · zoomed to data range



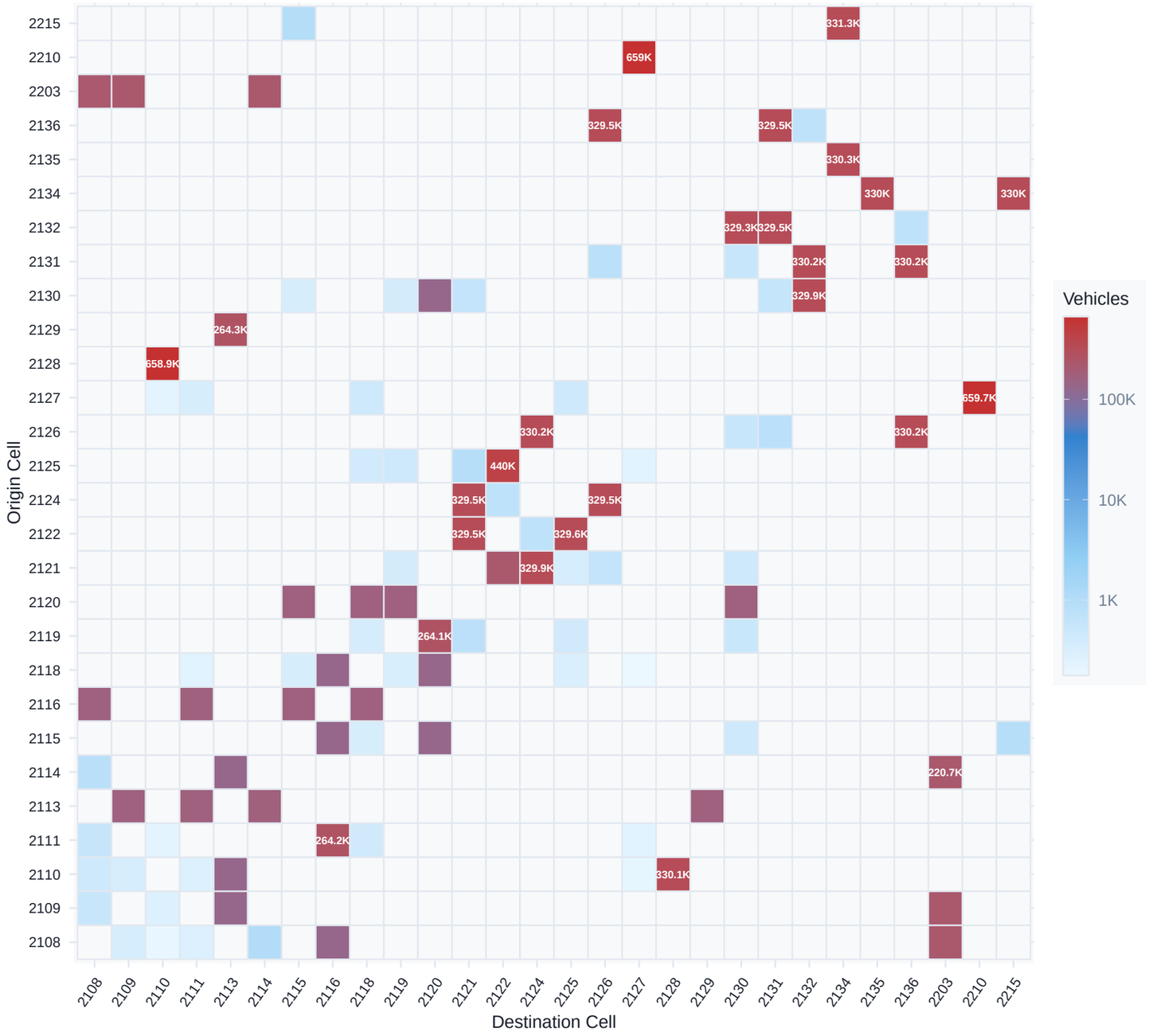
Cell Throughput Efficiency

Total outflow / (avg vehicles × timesteps) — higher = more efficient throughput



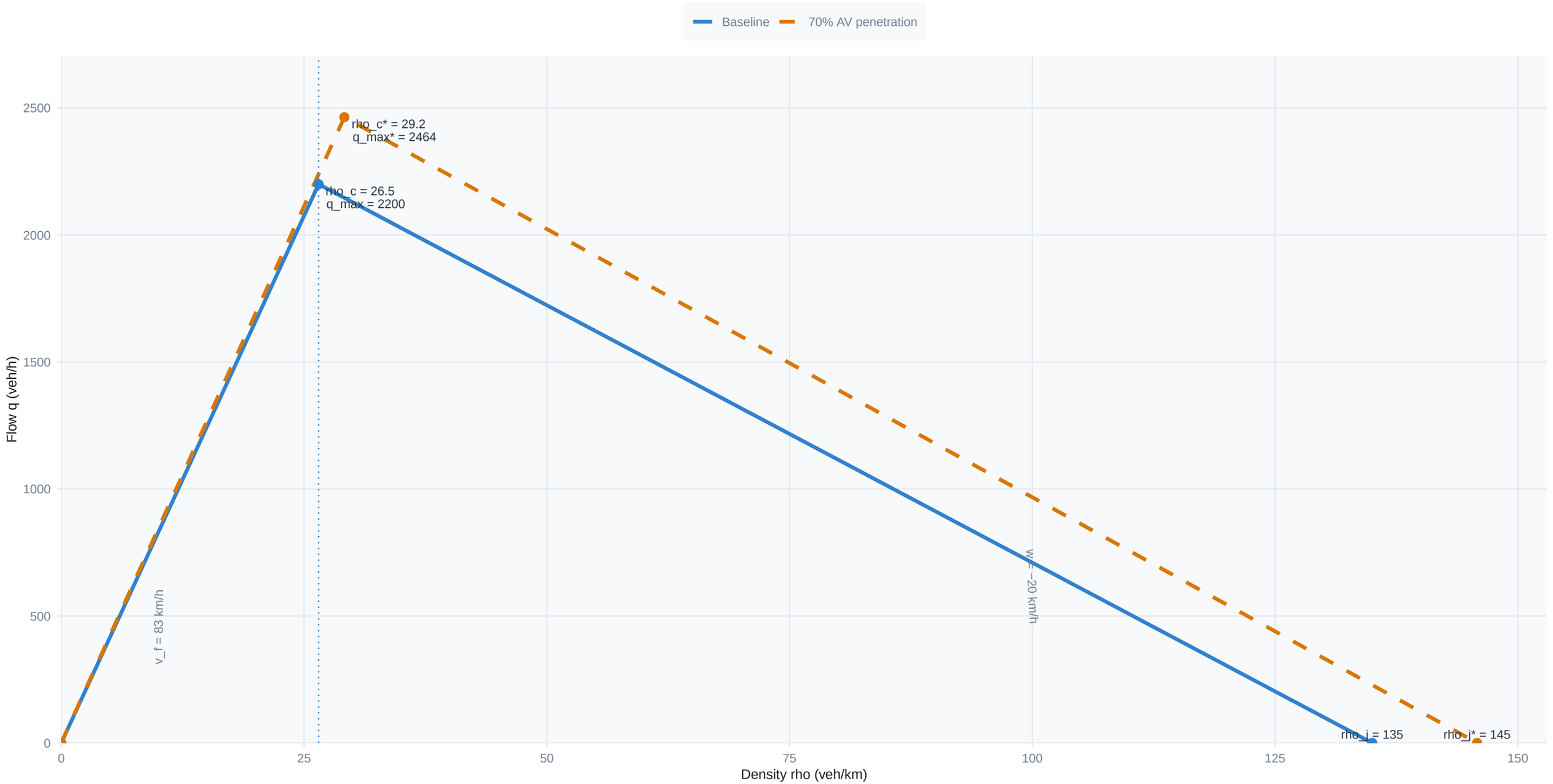
Cumulative Origin–Destination Flow Matrix

Total vehicles exchanged between cell pairs · empty cells = no direct connection · labels on top 25% flows



Triangular Fundamental Diagram

Baseline: v_f = 83 km/h, w = −20 km/h, rho_c = 26.5 veh/km, q_max = 2200 veh/h, rho_j = 135 veh/km
Dashed = AV−modified curve at p = 70% penetration (shifted apex)



Congestion Heatmap − Boston ZIP Network

Mean density (rho/rho_j) per cell across simulation · rho_j = 135 veh/km · bottleneck = cell 2116 (0.50 x jam density)