We formulate the auto-ATC as a continuous-time MDP. The probability of transitioning to state $s'$ from state $s$ is exponentially distributed $\sim q(s) e^{-q(s)t}$.

The mean sojourn times $T(s)$ can be collected in a matrix $M_M = \begin{bmatrix} T_1 & T_2 & \cdots & T_n \end{bmatrix}$.

The probability of transitioning to state $s''$ from $s'$ is:

$$T(s'' \mid s', a) = \begin{cases} 0 & \text{if } s'' \notin \mathcal{S}, \mathcal{S} = \{s_1, s_2, \ldots, s_n\} \\ \frac{1}{q(s')} & \text{if } s'' \in \mathcal{S} \text{ and } s'' = \text{commanded next location} \\ \frac{1}{q(s')} & \text{if } s'' \in \mathcal{S} \text{ and } s'' \neq \text{commanded next location} \\ \text{not valid command} & \text{otherwise} \end{cases}$$

$T$ and $M_M$ can be combined into intensity matrices $Q_M$ (one for each action):

$$Q_M = M_M T + I$$

$Q_M$ describes the behavior of one agent. If we have $K$ agents, we use Kronneker algebra to compute the joint intensity matrix $Q$.

In the special case of independent transition events:

$$Q(a, a_0) = q(a_0) \odot \cdots \odot q(a_0) \odot \cdots \odot q(a)$$

$\odot$ represents the Kronecker product, which allows for generic distributions, but is non-Markovian.

CTMDP uses exponential sojourn time, which does not match data.

GSMDP collapses to a CTMDP with more states.