# 15.Cell Transmission Model

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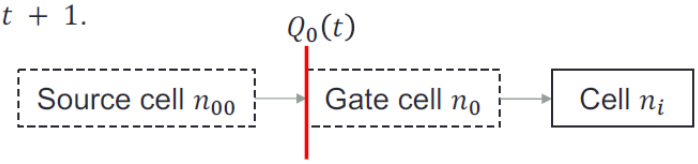
Consider a link with three cells. Suppose that time is divided into 1 second intervals.

- At most 10 vehicles can move from one cell to the next cell in one time step, i.e., $q_{max}\Delta t = 10$.
- The maximum number of vehicles that can fit a cell $N_i = 30$.
- $w/v_f = 2/3$
- The demand for vehicles trying to enter the link is known $d(t)$.

Now also assume that at the downstream end, a traffic light is red from $t = 0$ to $t = 9$ and will turn green forever at $t = 10$. Use the spreadsheet provided to calculate cell occupancies over time.

设置 demand by a cell pair，

A *source* cell numbered *00* with an infinite number of vehicles ($n_{00}(0) = \infty$) that discharges into an empty *gate* cell *0* of infinite size, $N_0(t) = \infty$. The inflow capacity $Q_0(t)$ of the gate cell is set equal to the desired link input flow for next time interval $t + 1$.




则如图 1：

| time | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| n00 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 | 9999 |
| n0 | 0 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 14.4 | 21.9 | 26.2 | 25.3 | 22.3 | 19.5 | 17.5 | 16.3 | 15.6 | 15.3 | 15.1 | 15.1 | 15 |
| n1 | 0 | 0 | 10 | 10 | 10 | 10 | 10 | 10 | 14.1 | 21.6 | 26.2 | 28.4 | 24.9 | 20.8 | 18 | 16.5 | 15.7 | 15.3 | 15.1 | 15.1 | 15 | 15 | 15 |
| n2 | 0 | 0 | 0 | 10 | 10 | 10 | 13.3 | 21.1 | 26.3 | 28.5 | 29.4 | 23.1 | 18.8 | 16.6 | 15.7 | 15.3 | 15.1 | 15 | 15 | 15 | 15 | 15 | 15 |
| n3 | 0 | 0 | 0 | 0 | 10 | 20 | 26.7 | 28.9 | 29.6 | 29.9 | 20 | 16.7 | 15.6 | 15.2 | 15.1 | 15 | 15 | 15 | 15 | 15 | 15 | 15 | 15 |
| nout | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 |

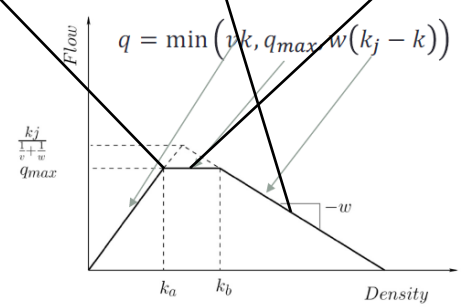



图 1：0-22s 仿真结果

附件 1：

40s 仿真完整表格

| time | n00 | n0 | n1 | n2 | n3 | nout |
|---|---|---|---|---|---|---|
| 0 | 9999 | 0 | 0 | 0 | 0 | 0 |
| 1 | 9999 | 10 | 0 | 0 | 0 | 0 |
| 2 | 9999 | 10 | 10 | 0 | 0 | 0 |
| 3 | 9999 | 10 | 10 | 10 | 0 | 0 |
| 4 | 9999 | 10 | 10 | 10 | 10 | 0 |
| 5 | 9999 | 10 | 10 | 10 | 20 | 0 |
| 6 | 9999 | 10 | 10 | 13.33333 | 26.66667 | 0 |
| 7 | 9999 | 10 | 10 | 21.11111 | 28.88889 | 0 |
| 8 | 9999 | 10 | 14.07407 | 26.2963 | 29.62963 | 0 |
| 9 | 9999 | 10 | 21.60494 | 28.51852 | 29.87654 | 0 |
| 10 | 9999 | 14.40329 | 26.21399 | 29.42387 | 19.95885 | 10 |
| 11 | 9999 | 21.87929 | 28.35391 | 23.11385 | 16.65295 | 20 |
| 12 | 9999 | 26.1957 | 24.86054 | 18.80658 | 15.55098 | 30 |
| 13 | 9999 | 25.30559 | 20.82457 | 16.63618 | 15.18366 | 40 |
| 14 | 9999 | 22.31824 | 18.03231 | 15.66784 | 15.06122 | 50 |
| 15 | 9999 | 19.46096 | 16.45599 | 15.26343 | 15.02041 | 60 |
| 16 | 9999 | 17.45765 | 15.66095 | 15.10141 | 15.0068 | 70 |
| 17 | 9999 | 16.25985 | 15.28792 | 15.03834 | 15.00227 | 80 |
| 18 | 9999 | 15.6119 | 15.12153 | 15.01429 | 15.00076 | 90 |
| 19 | 9999 | 15.28499 | 15.05004 | 15.00527 | 15.00025 | 100 |
| 20 | 9999 | 15.12836 | 15.02019 | 15.00192 | 15.00008 | 110 |
| 21 | 9999 | 15.05625 | 15.00801 | 15.0007 | 15.00003 | 120 |
| 22 | 9999 | 15.02409 | 15.00314 | 15.00025 | 15.00001 | 130 |
| 23 | 9999 | 15.01012 | 15.00121 | 15.00009 | 15 | 140 |
| 24 | 9999 | 15.00418 | 15.00046 | 15.00003 | 15 | 150 |
| 25 | 9999 | 15.0017 | 15.00018 | 15.00001 | 15 | 160 |
| 26 | 9999 | 15.00069 | 15.00007 | 15 | 15 | 170 |
| 27 | 9999 | 15.00027 | 15.00002 | 15 | 15 | 180 |
| 28 | 9999 | 15.00011 | 15.00001 | 15 | 15 | 190 |
| 29 | 9999 | 15.00004 | 15 | 15 | 15 | 200 |
| 30 | 9999 | 15.00002 | 15 | 15 | 15 | 210 |
| 31 | 9999 | 15.00001 | 15 | 15 | 15 | 220 |
| 32 | 9999 | 15 | 15 | 15 | 15 | 230 |
| 33 | 9999 | 15 | 15 | 15 | 15 | 240 |
| 34 | 9999 | 15 | 15 | 15 | 15 | 250 |
| 35 | 9999 | 15 | 15 | 15 | 15 | 260 |
| 36 | 9999 | 15 | 15 | 15 | 15 | 270 |
| 37 | 9999 | 15 | 15 | 15 | 15 | 280 |
| 38 | 9999 | 15 | 15 | 15 | 15 | 290 |
| 39 | 9999 | 15 | 15 | 15 | 15 | 300 |
| 40 | 9999 | 15 | 15 | 15 | 15 | 310 |

附件 2：
代码

```
import pandas as pd

table = pd.read_excel('demand.xlsx')
table.head()

Q = 10
N = 30
table['n00'] = 9999
table.iloc[0,2:7]=0
table.head()

for i in range(len(table)):
    # 当 0s 时已初始化完毕
    if i==0:
        continue

    for j in range(2,6,1):
        q1 = min(10,table.iloc[i-1,j-1],2/3*(N-table.iloc[i-1,j])) #q1 为流入，q2 为流出
        if i<=9 and j==5: #此为红灯状态
            q2 = 0
        elif j==5: #红灯结束但为最后一个 cell
            q2 = min(10,table.iloc[i-1,j])
        else: #红灯结束其它 cell
            q2 = min(10,table.iloc[i-1,j],2/3*(N-table.iloc[i-1,j+1]) )
        table.iloc[i,j] = table.iloc[i-1,j]+q1-q2
    # 统计流出量
    table.iloc[i,6] = table.iloc[i-1,6]+q2
table.to_excel('output.xlsx',index=False)
```