Lab 7
Transit System and Data

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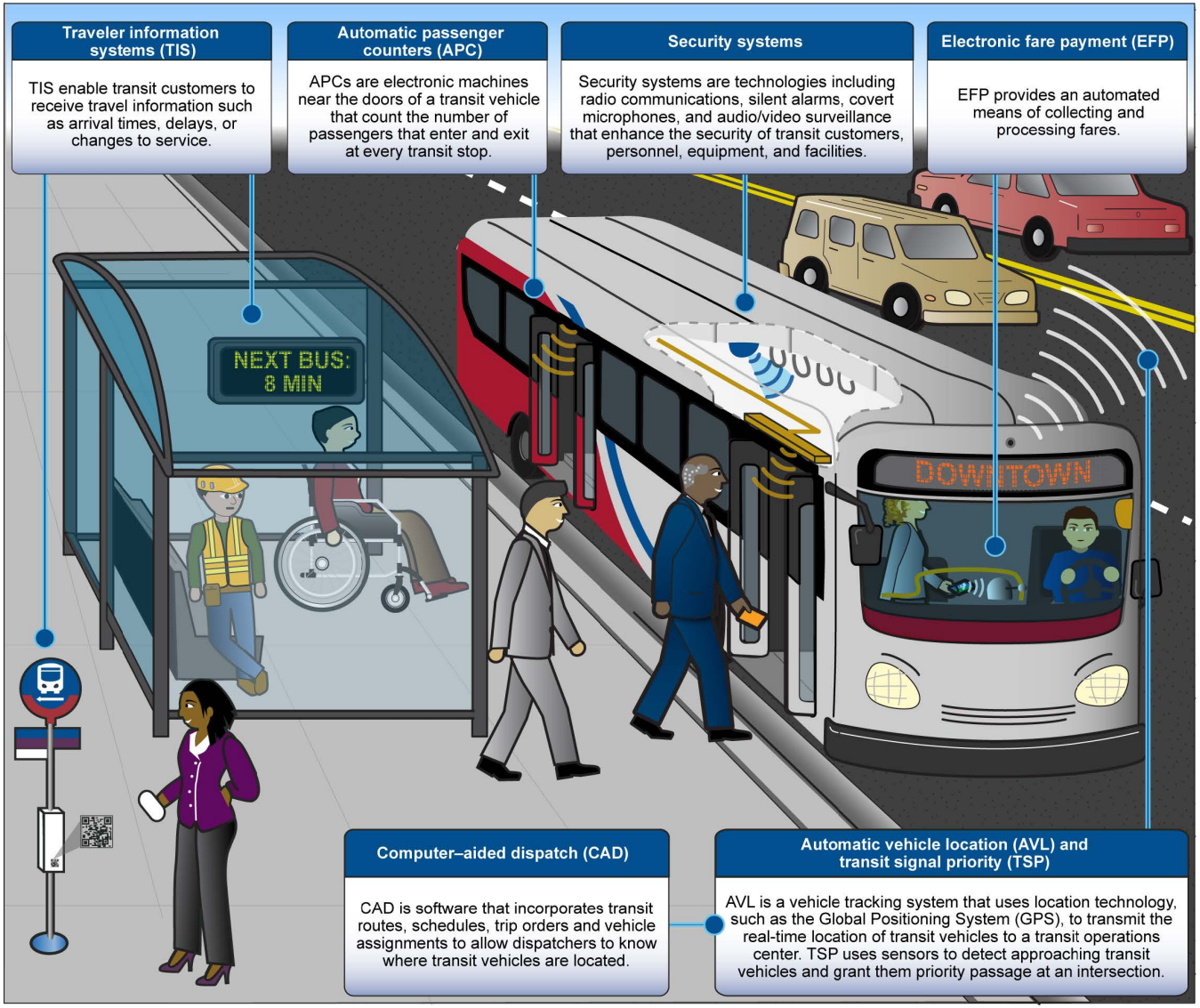
Announcements

- Lab session mid-term evaluation: online survey
- $\sim$ Sat/Sun

Objectives

- Become familiar with transit system data: AFC, APC, and AVL
- Estimate average boarding and alighting time using multi-source data

Technologies in transit systems



Source: GAO analysis of Department of Transportation documents. | GAO-16-638

Figure: Technologies in transit systems[1]

[1] https://blog.gao.gov/2017/05/15/technology-in-transit/

Automated Fare Collection (AFC) and data

Figure: Automated fare collection system data[2]

[2] https://www.scsoft.com/automated-fare-collection/

Automated Passenger Counting (APC) and data

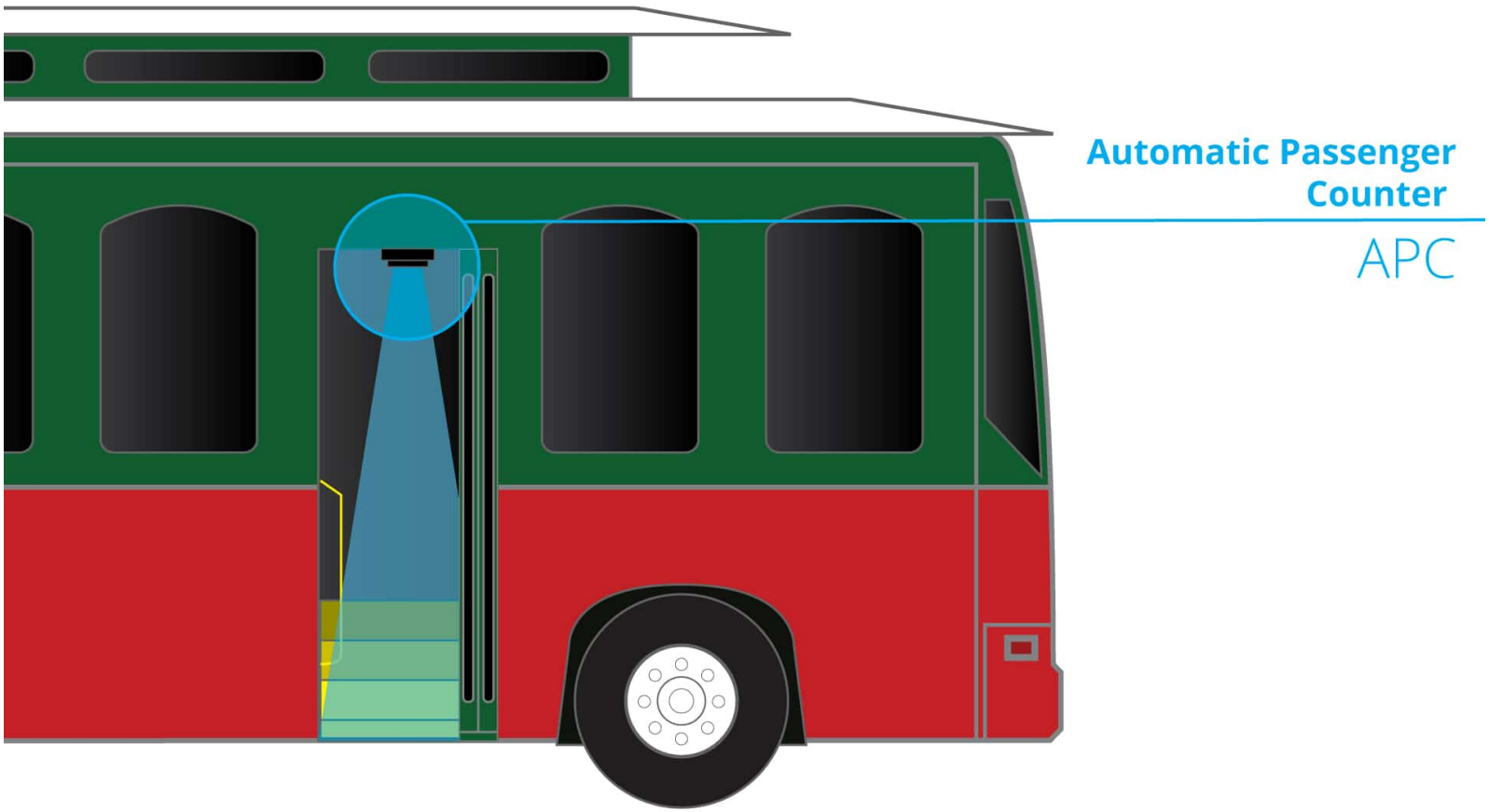


Figure: Automated passenger counting system[3]

[3] https://www.tsomobile.com/tso-public-transportation/trolley-resources/1525150132387-e97a143b-59d5

Automated Fare Collection (AFC) and data

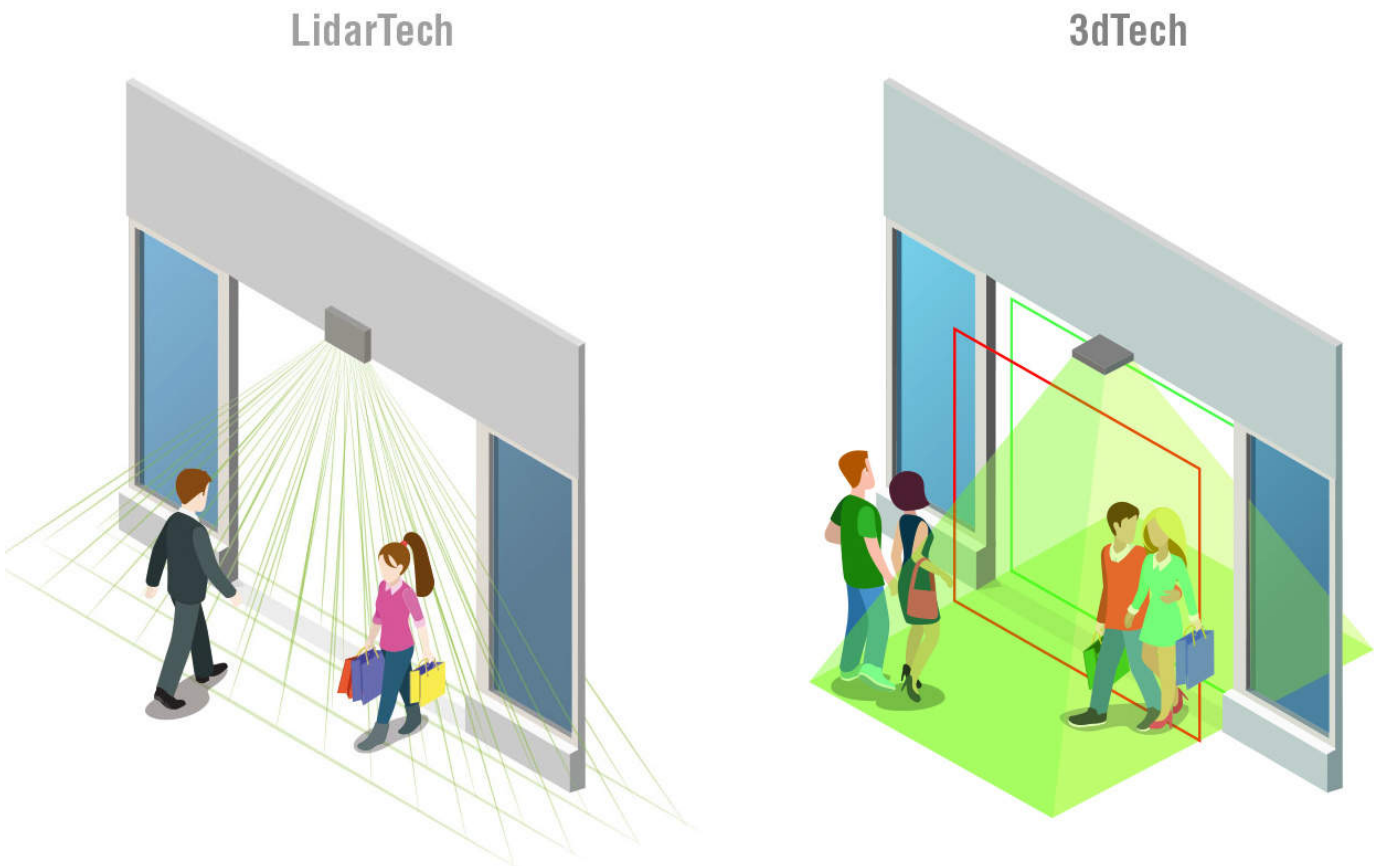


Figure: New technologies in AFC[4]

[4] https://www.railway-technology.com/products/high-precision-sensors

Automated Vehicle Location (AVL) and data

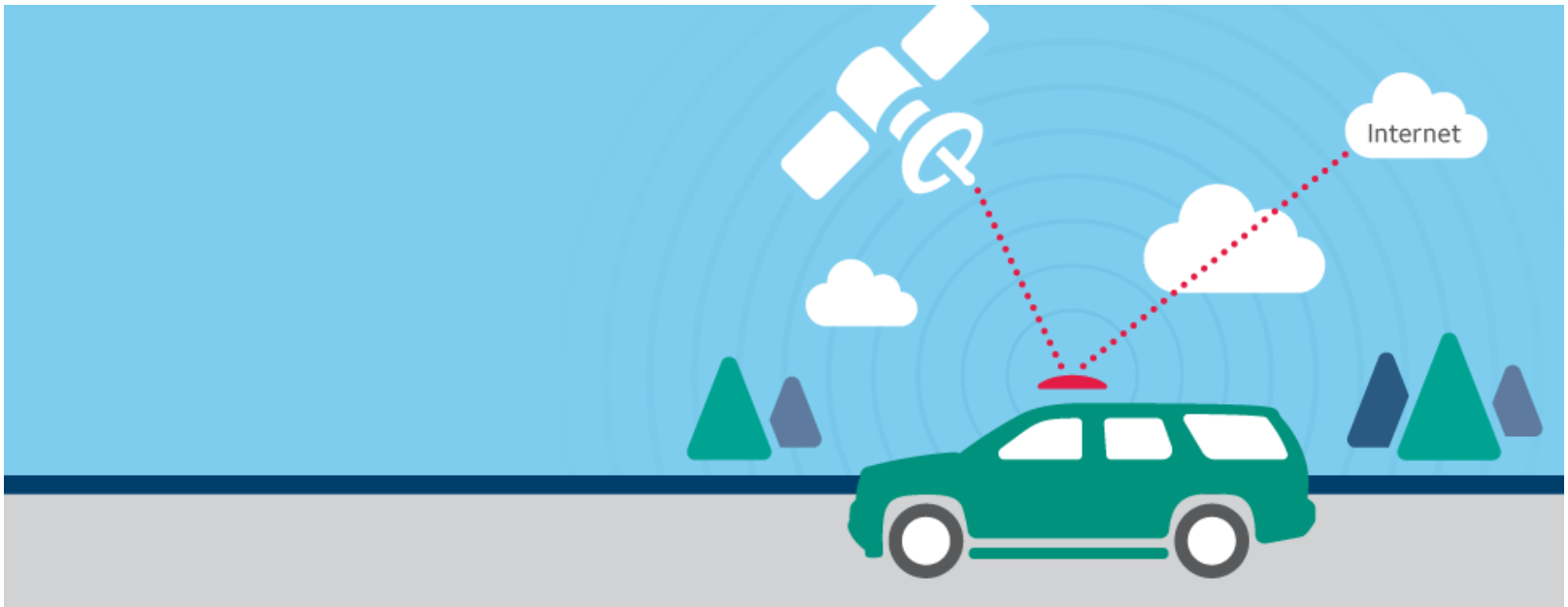


Figure: Automated vehicle location system[5]

[5] https://www.novatel.com/industries/autonomous-vehicles

Background

- Bus dwell time is highly dependent on number of boarding and alighting passengers
- The boarding and aligting processes can take place simultaneously in some systems
- Boarding generally takes longer time than alighting in certain systems
- Assume that dwell time is only a function of boarding and alighting passengers

$$D(B, A) = \max\{\alpha_1 B, \alpha_2 A\} + C \tag{1}$$

where D is bus dwell time(in seconds), B, A are boarding and alighting passengers,α_1, α_2 and C are parameters to be estimated.

Estimation

Difficulty and solution

- Nonlinear function
- Iterative approximation

$$D(B, A) = \max\{\alpha_1 B, \alpha_2 A\} + C \tag{2}$$

$$= \alpha_1 \max\{B, \frac{\alpha_2}{\alpha_1} A\} + C \tag{3}$$

$$= \alpha_1 \max\{B, \gamma A\} + C \tag{4}$$

where $\gamma = \frac{\alpha_2}{\alpha_1}$. Now we can estimate the model each time for a fixed γ.

In R ...

Data set is already prepared for you from AVL and APC of A Line.

Check the document "Boarding and alighting time estimation.pdf"