OKOS VÁROS
@ BME TMIT

Intelligent Transportation Systems

Lecturers

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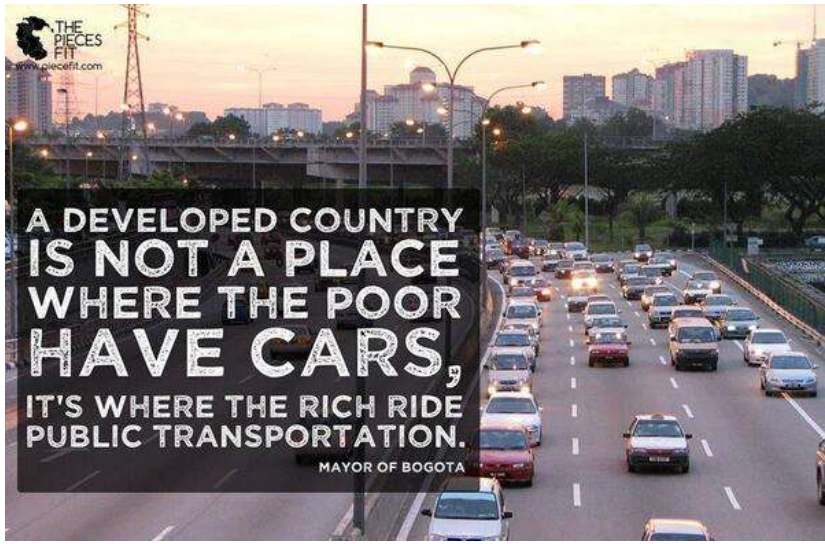
Tell us about yourself…

- Where do you come from?
- What main specialization?
- What is your background (BSc) ?
- How much do you know about transportation systems?
- How much do you know about networking, communication?
- Programming skills? Hardware or software?
- Why did you choose this course, what are your expectations?

Intelligent transportation systems

- Smart City
  - A place where people like to live, good quality of life
  - Low pollution, low energy consumption
  - Sustainability
  - Adaptability
- One of the basic components of a smart city is the intelligent transportation system
  - Too many people in traffic jams – stress, lost working hours
  - Too many people in cars – pollution, energy wastage
    - In Budapest ~ 1 million cars, each year increasing with 20-30,000 cars
    - Out of the 3 million cars in total in Hungary
  - **Too many cars**
    - Cars stay parked, empty, for 22 hours per day in average
    - Occupy a parking lot, at home or at work
- **The use of personal cars in not sustainable on the long run**
  - Thanksgiving traffic in Los Angeles

Intelligent transportation systems



- Efficient public transportation
- Car sharing / Car pooling
- Connected car, C2C or V2V communication
- Intelligent road network, C2I or V2I communication
- Today mostly static traffic signs, like 100 years ago

- Electric cars
- Self-driving cars

Intelligent public transportation

Improving the efficiency and quality of public transportation is very important

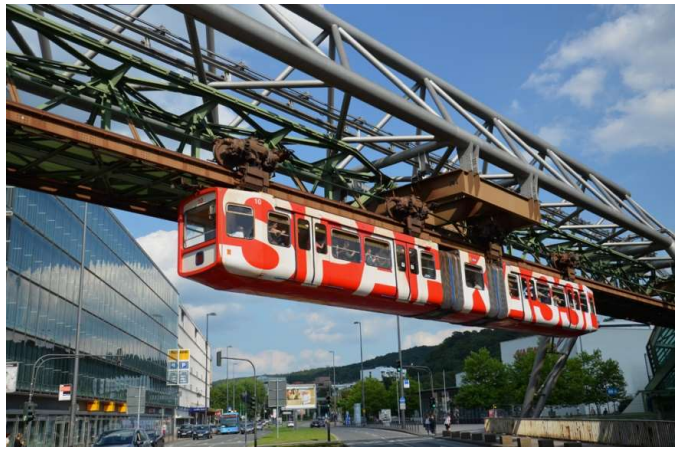
- Bad example from the metro in Beijing (2013)
- https://www.youtube.com/watch?v=xG-meaGqg-M

- If too many people and bad public transportation – be aware of the motrocycles
  - Total chaos in transportation – see South-East Asia

- Crossroad in Saigon
- **http://www.youtube.com/watch?v=gKLWZjBu2iQ**

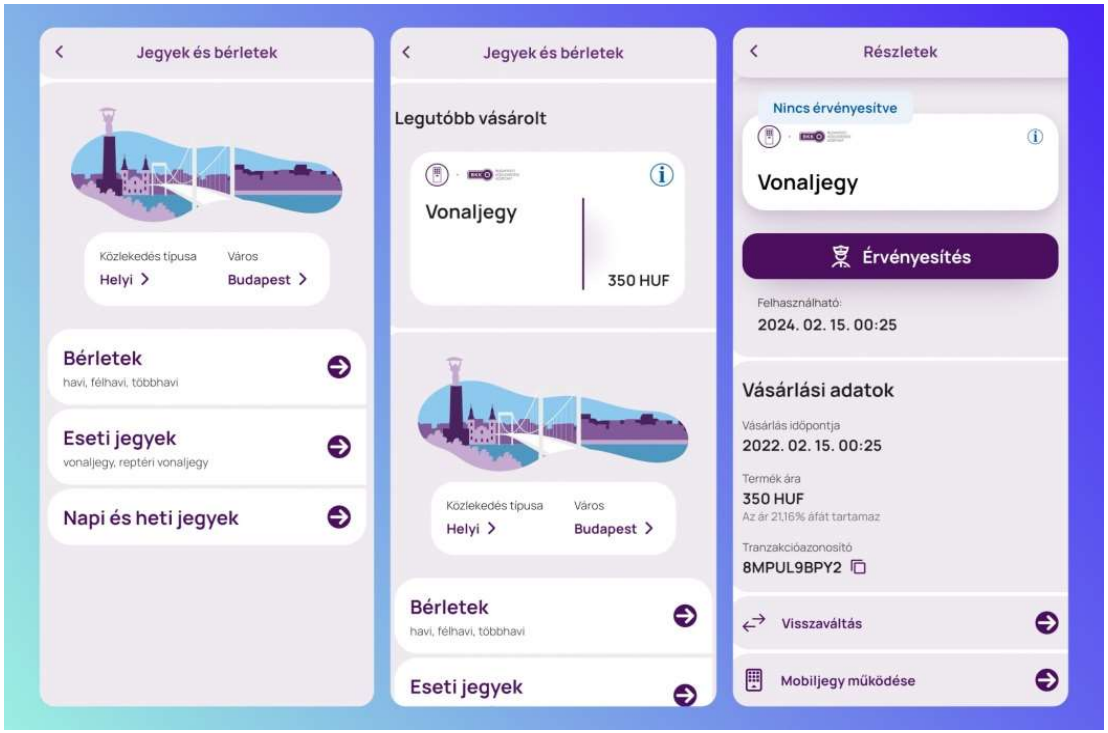
Advantages of public transportation

- **Much larger capacity**
  - 200 people – on 200 bikes, 1 tram, 3 buses or 177 cars
- **Reliability, predictability**
  - Real-time monitoring of vehicles (GPS), trajectory planning
  - Track-based solutions – underground, ground level or elevated



BKK Futár – Budapest Go

- Started in 2014, for a cost of 6 billion HUF
- GPS on 1597 buses, 551 trams, 141 trolley buses
- 263 screens in stations
- Mobile app



Adaptivity in public transportation

- Currently, schedules based on historic data
  - Time of the day, day of the week, holidays
- Would be good to adapt to the current conditions, current demand
  - Higher than usual, or lower
  - Strikes, road closures, public events, Covid
- Needs additional capacity in buses, drivers
  - Not easy to implement

BRT (Bus Rapid Transfer)

- Dedicated bus lane, possibly in the middle of the road (easy turning)
- Paying (by card) outside the vehicle, not at the driver – faster boarding
- Green lights at crossroads

BRT (Bus Rapid Transfer)

Passing lanes at stations have increased the capacity of the system threefold

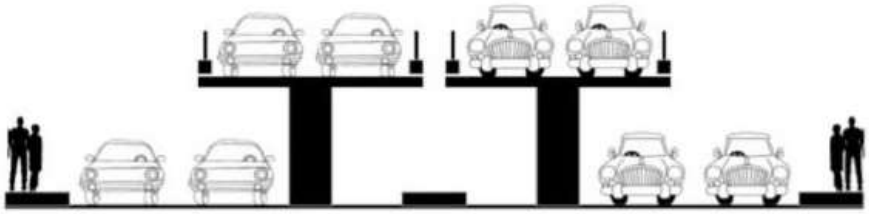
TransMilenio, Bogota, Columbia

Walter Hook, Stephanie Lotshaw, and Annie Weinstock, More Development For Your Transit Dollar: An Analysis of 21 North American Transit Corridors, https://www.itdp.org/wp-content/uploads/2013/11/More-Development-For-Your-Transit-Dollar_ITDP.pdf

BRT (Bus Rapid Transfer)

3-lane carriageway

2 lanes + elevated road



Dedicated lanes for bus rapid transit

Capacity:

3,000 passengers per hour per direction

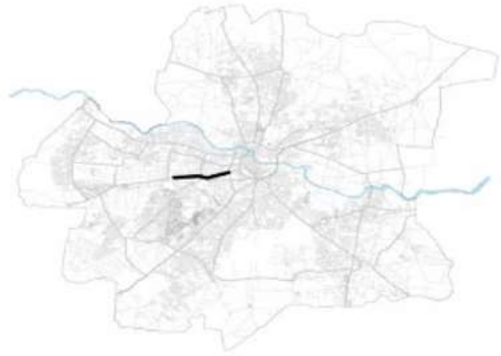
4,700

12,000 +

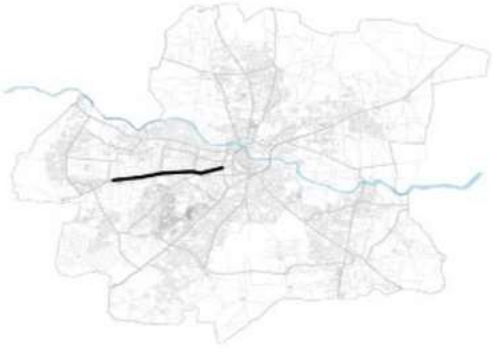
How much does it cost?

- **What could you build with 10 billion rupee (~ 156 million USD)?**

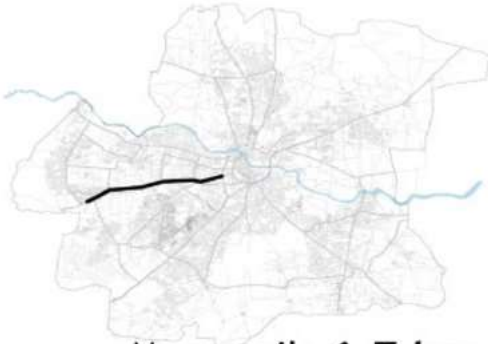
- The BRT is the cheapest solution, but cannot be applied everywhere
  - No space
  - Should not build the city for the cars, but for people
  - Building roads for buses is more acceptable than for cars



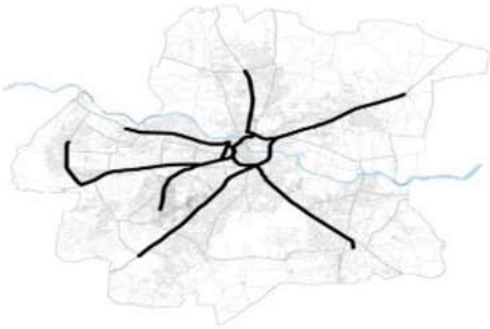
Underground metro: **2.5 km**



Elevated metro: **5.0 km**



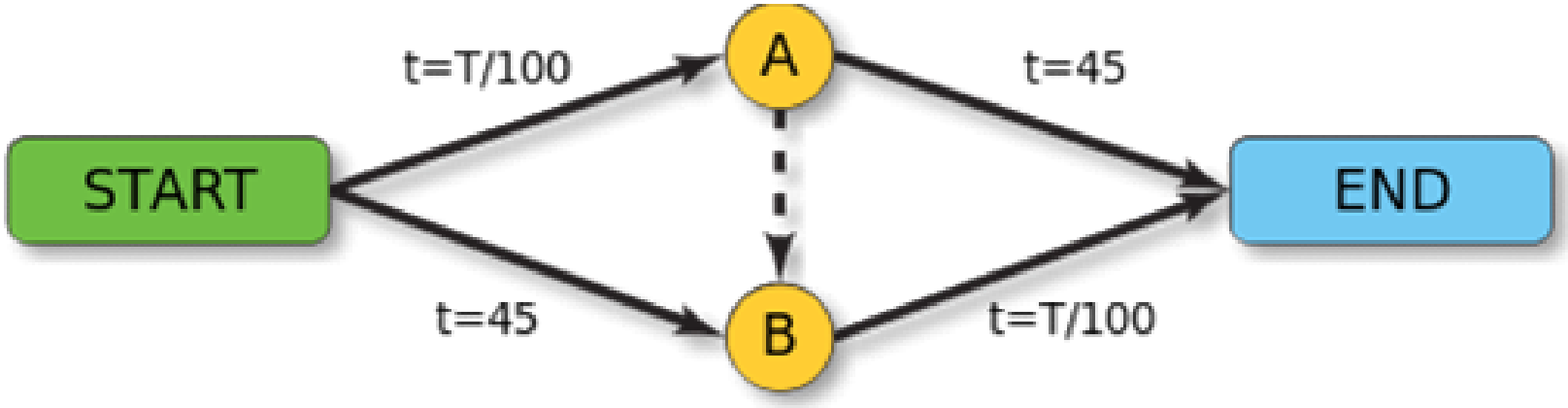
Monorail: **6.7 km**



BRT: **67 km**

Braess paradox (1968)

- Dietrich Braess, German mathematician
- Adding a new connection to the network will not necessarily increase the overall capacity



Bringing down some roads

Seoul, South-Korea

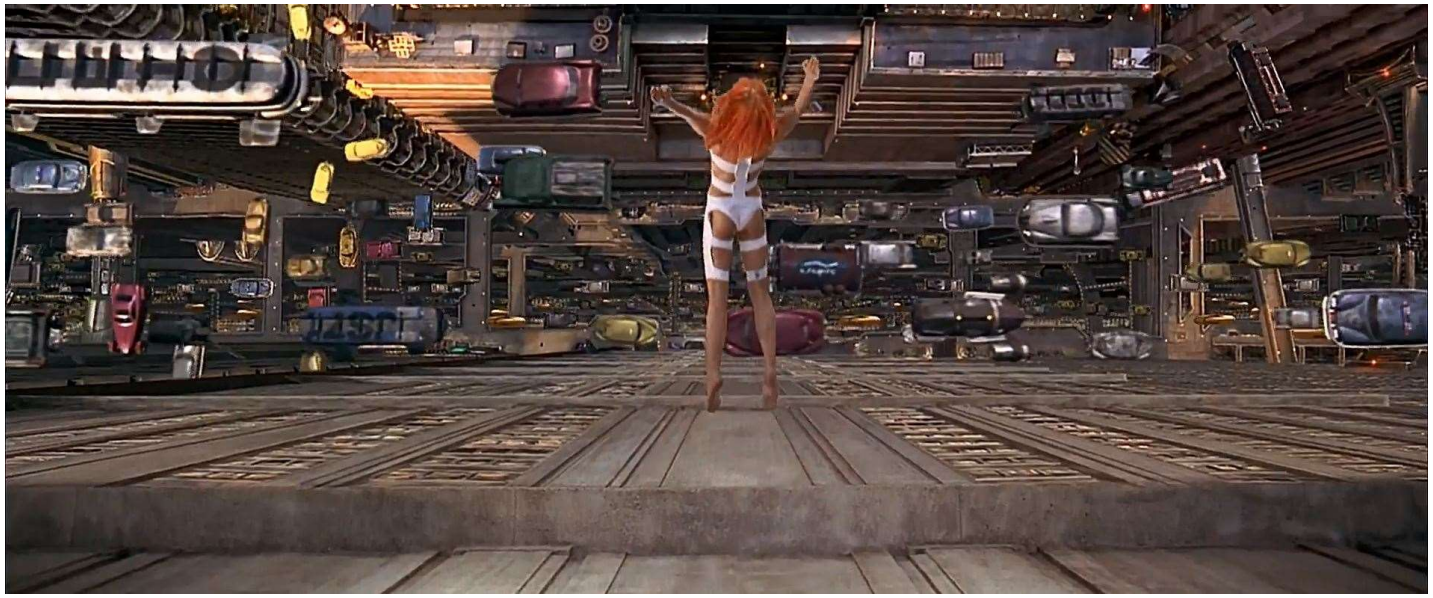
Portland, Oregon

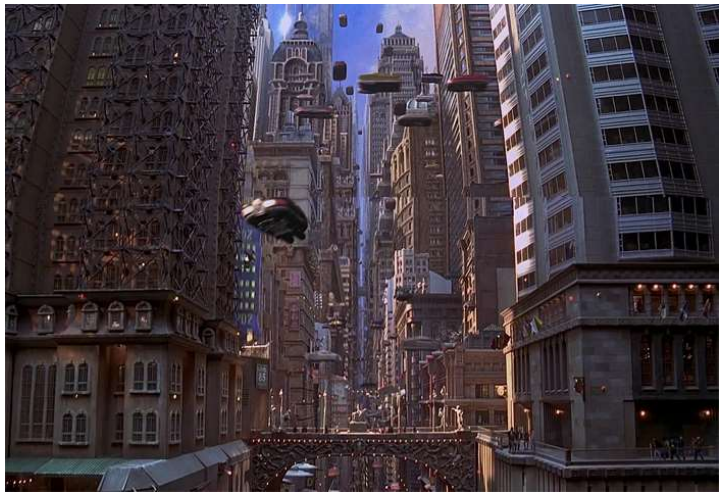
Bringing down some roads

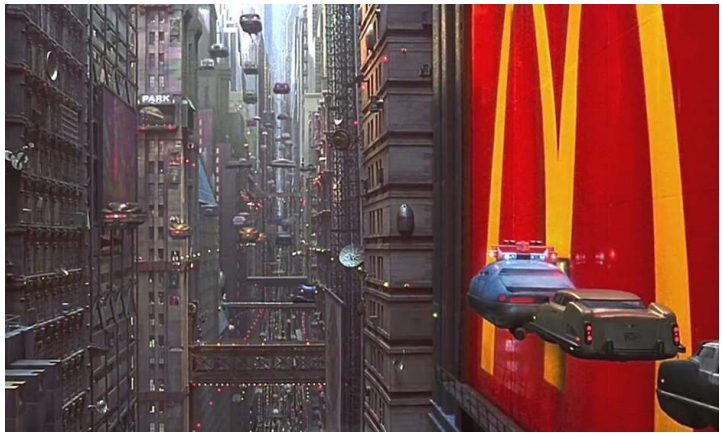
Amsterdam, 1975 - 2005

Futuristic ideas

- Remember Leeloo's jump scene, in the Fifth Element?







https://www.youtube.com/watch?v=pK_sGCG-L_c

Futuristic ideas

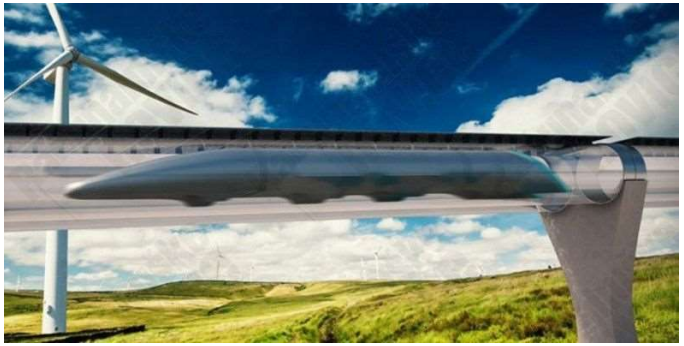
- Gyroscopic transportation, on multiple heights

https://www.youtube.com/watch?v=1m5vWdeTlno

Futuristic ideas

Elon Musk (46)

- **PayPal** – online payment system
  - Bought by eBay in 2002 for $1.5 billion
- **SpaceX** – private space tourism, private satellites
- **Tesla** – electric cars
- **Solar City** – 2nd largest solar power provider in the US
- **Hyperloop** – transportation at 1200 km/h, in reducedpressure tubes



Futuristic ideas

Elon Musk (46)

- **The Boring Company** (2016)
  - System of underground tunnels for rapid transportation
  - Digging started in LA in the summer of 2017

https://www.youtube.com/watch?v=uI3oJqMBpPs

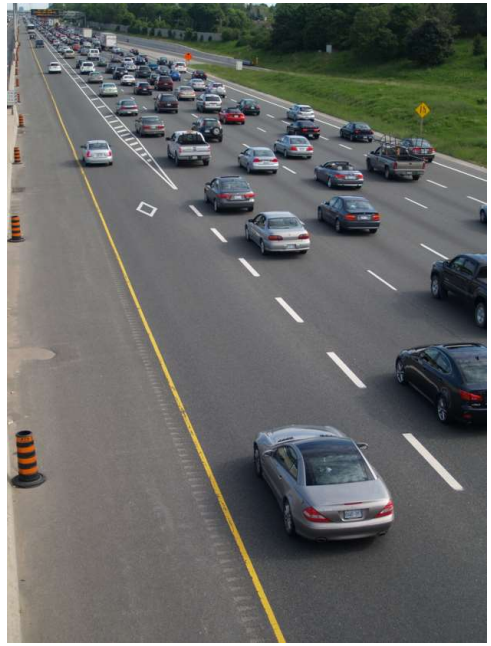
AVO, SOV, ZOV, HOV

- The drawback of public transportation is that it does not reach individual homes everywhere
  - Especially in the suburbs and the agglomeration
  - People should reach the end stations somehow – usually by car
- Most people commuting from the agglomeration are alone in their car
- **AVO – Average Vehicle Occupancy**
  - In Western-Europe, USA around 1.5-1.6, but contantly decreasing
    - During peak traffic 1,1 – 1,2
  - Higher averages in deveoping countries, but because of economic reasosn, not because of being „green”
- **SOV – Single Occupancy Vehicles**
  - In peak times 85-90%
- **ZOV – Zero Occupancy Vehicles**
  - With the deployment of autonomous cars and „ride sharing”
- **HOV – High Occupancy Vehicles**
  - Incentives for people to do car pooling

Car pooling

- More people in a car, fewer cars, lower pollution, cheaper rides
- Simplest car pooling solution - hitchhiking
- Many solutions but hard to optimize the matchmaking between drivers and passengers, problems of reliability, flexibility, trust

HOV Lanes



- HOV – High Occupancy Vehicles
  - Can only be used if at least one passenger next to the driver
    - Usually limited to peak times
  - Buses, electric cars, motorbikes
  - Cars with just a driver, but who is willing to pay for it
    - HOT (High Occupancy Toll) Lane
    - Price changes depending on demand
- First bus lane in US in Washington (1969)
  - From 1973 turned into HOV 3+
  - Results of a 2005 study:
    - Morning rush hours, 6.30-9.30, 31.700 people in 8.600 HOV cars (3.7 AVO), 29 minutes ride
    - In normal lanes 23.500 people in 21.300 cars (AVO 1.1), 64 minutes ride

Bus and HOV lanes

- Around the world
  - USA, China
  - Less in Europe
- HOV control with cameras
  - Inflated dolls or paper cuts on the side seat
  - Heat cameras
- Against the law, fines by the police
  - Nashville, 108 miles HOV, 130.000 commuters / day
    - 95% unjustified use, fines of only 50 USD
  - California, North Virginia – fines up to 1000 USD

HOV jockeys

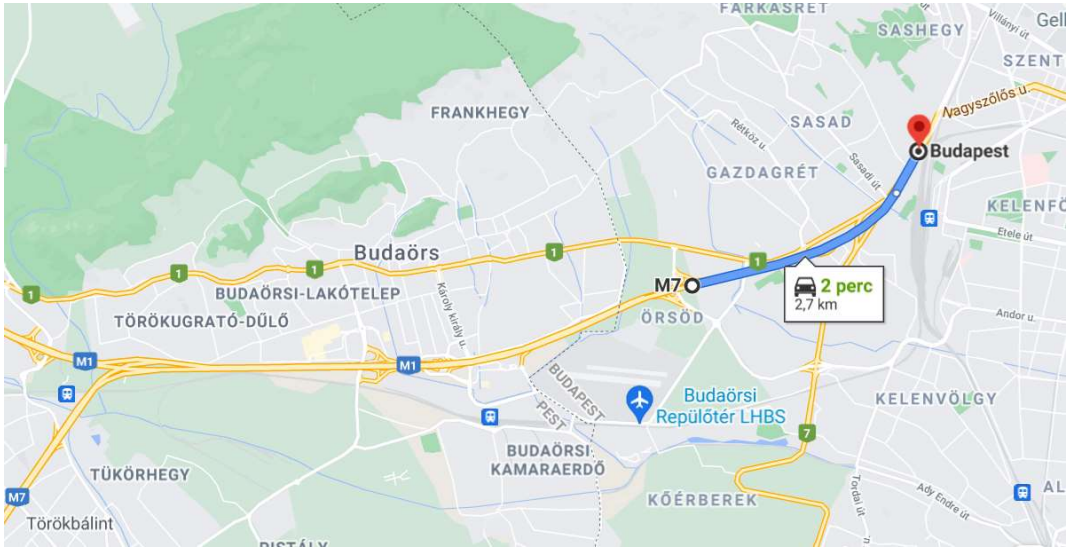
- Jakarta, Indonesia – HOV3+ lanes since 2003
  - Unemployed people, kids, mothers with their children „working” as „jockeys”, for money (1-2 USD / ride)
  - Many moved to the capital for this
  - 10-15 USD/day, not bad compared to the 600 USD/ month average salary
- Did not reach its goals, no decrease in the number of cars
- Discontinued in 2016, new system a few months later
  - Even plate numbers on even days, odd plate numbers on odd days

Bus and HOV lanes

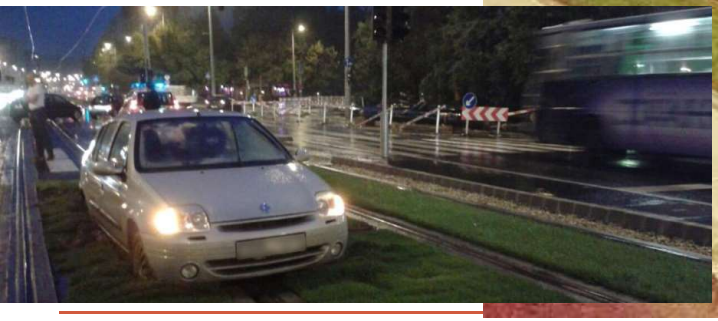
- **Drawback – sparsely used lanes**
- Experiment introduced in Lisbon in 2007
  - Bus lane only if a bus is approaching (based on sensors, timetables, or GPS)
  - Light and sound signals to the other drivers
- Some HOV lanes discontinued in Australia
  - **If sparsely used, it increases the pollution**
    - Fewer traditional lanes, slower traffic, larger fuel consumption
  - **If used by many, and efficient, it becomes an incentive to buy new cars**

HOV lanes in Budapest

- Bus lane on the M1-M7 highway entering the city
- First try for 4 days (2011)
- From 2014 on the shoulder (breakdown/emergency lane)
  - Reduced speed, but does not disturb normal lanes



Dedicated lanes – should be respected



The Uber myth

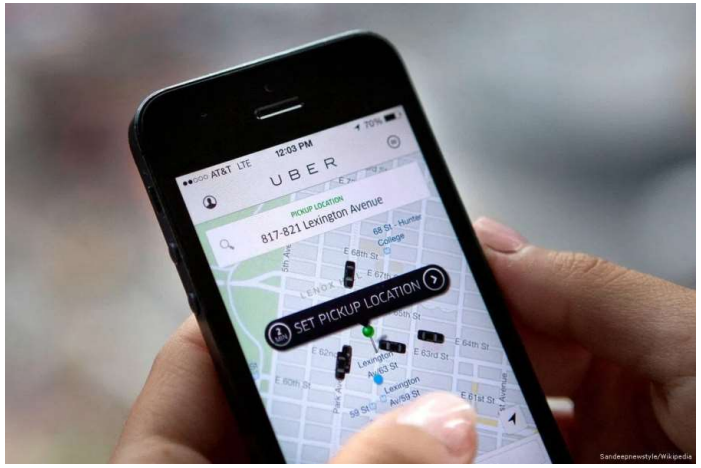
Uber – one of the most innovative, and best known transportation apps of the last years

- **Is it a smart city, or a dumb city app?**

UBER

How it works?

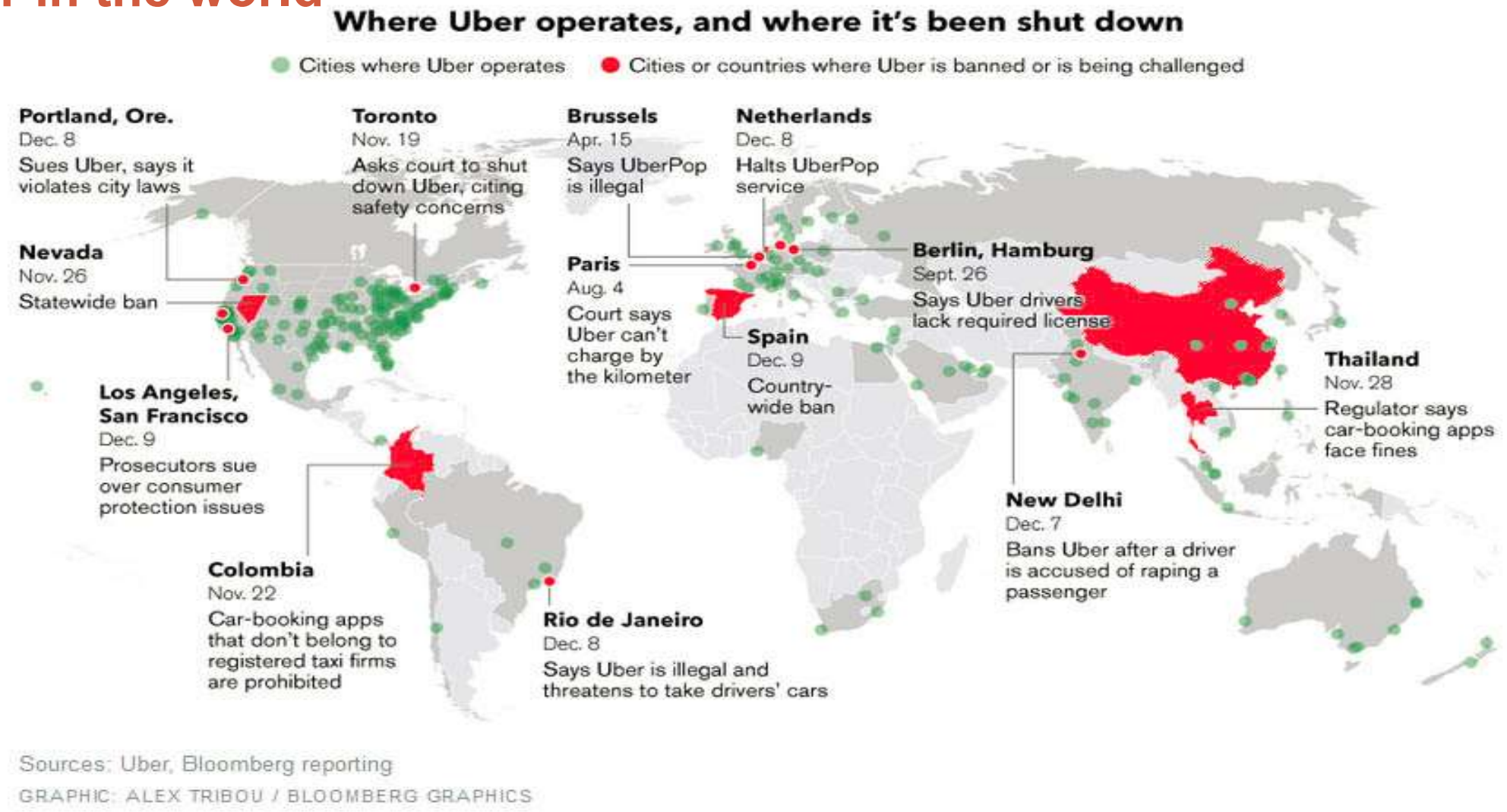
- Free to download
- Registered credit card
- Fast response for a ride request
  - 3-5 minutes
- Surge pricing, based on demand
- Automatic payment
- Drivers are private people
- Fast, simple, cheap



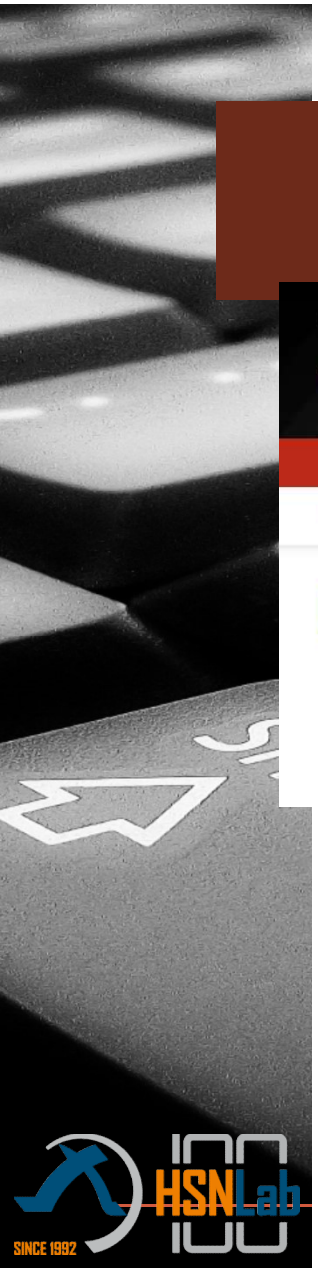
Uber in numbers

- **2009** - launched in San Francisco
- **19 000** employees around the world
- **9 million** Uber drivers
- **65** countries, **600** cities
- **14 million** rides per day
- **100 billion** USD market value
- **14 billion** USD revenue in 2019
- **8,5 billion** USD loss in 2019

Uber in the world



Uber = peer-to-peer ridesharing ??



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NEWS / TECH / UBER TO TEST PEEF

THIS STORY IS FROM OCTOBER 2

Uber to test
sharing in Pu

Corpus ID: 169256353

The impact of peer-to-peer ridesharing on travel mode: Empirical study of Uber effects on travel

WIKIPÉDIA
A szabad enciklopédia

szócikk | vitalap

Március 21. és május 31. között ismét nevezhetsz szóc
országokr

Kezdőlap
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Lap találomra
Tudakozó

Uber [bevezető szerkesztése]

A Wikipédiából, a szabad enciklopédiából

Az **Uber** egy P2P utazásmegosztó személyszállító szolgáltatás.

Uber = peer [NO !] eer ridesharing ??

- **Peer-to-peer (P2P) – opposite to client- server**
  - No dedicated tasks and resources, sometimes operating as client, sometimes as server
  - Bittorrent, Vatera, FON, Waze

- **Uber is not a P2P service**
  - A Uber driver will not be a Uber passenger
    - Or just very rarely
  - This is not needed for the service to work

Uber = Ridesharing?

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With ride-sharing curbed during the pandemic, Uber and Lyft try new routes to profitability

By DAMIAN J. TROISE
ASSOCIATED PRESS | FEB 19, 2021 AT 1:42 PM

· The Best Ride-sharing and Taxi apps in the USA

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Uber's ride-sharing service faces ban in Sp Netherlands

The New York Times

Uber's Food Delivery Business Nearly Matches Ride-Sharing

Last Updated March 1, 2021, 7:25 a.m. ET

HSNLab SINCE 1992

February 27, 2023

Intellige

Uber = Ride sharing?

NO!

- **Ride sharing or car pooling**
  - The driver goes to a given destination anyway
  - Takes other passengers going in the same direction
  - Not for profit, but fuel costs can be shared
  - Oszkár, Waze Carpool, GoKid

- Uber **is not a ride sharing** app
  - I take you because you pay, not because I want to go there anyway

Uber = ride-hailing?

NO!

- Uber cars **cannot be „hailed”**
  - The mobile app is needed

Uber = cheap taxi?

YES!

- **Organized transportation of people to specific destinations for a financial return = taxi**
- **Why is it cheap?**
  - Does not apply the same technical obligations, restrictions
  - Hidden employment
  - Tax avoidance
  - **Unrealistically small prices**
    - Huge losses, but the goal is increasing the market share, and bankrupting the competitors

Uber business model

- Surge pricing – based on demand and offer
  - If high demand, prices increase (Saturday night)
  - If low demand, prices decrease (Sunday morning)
  - **Adaptivity – smart city feature**

- 20-30% is Uber's share form the price of the ride

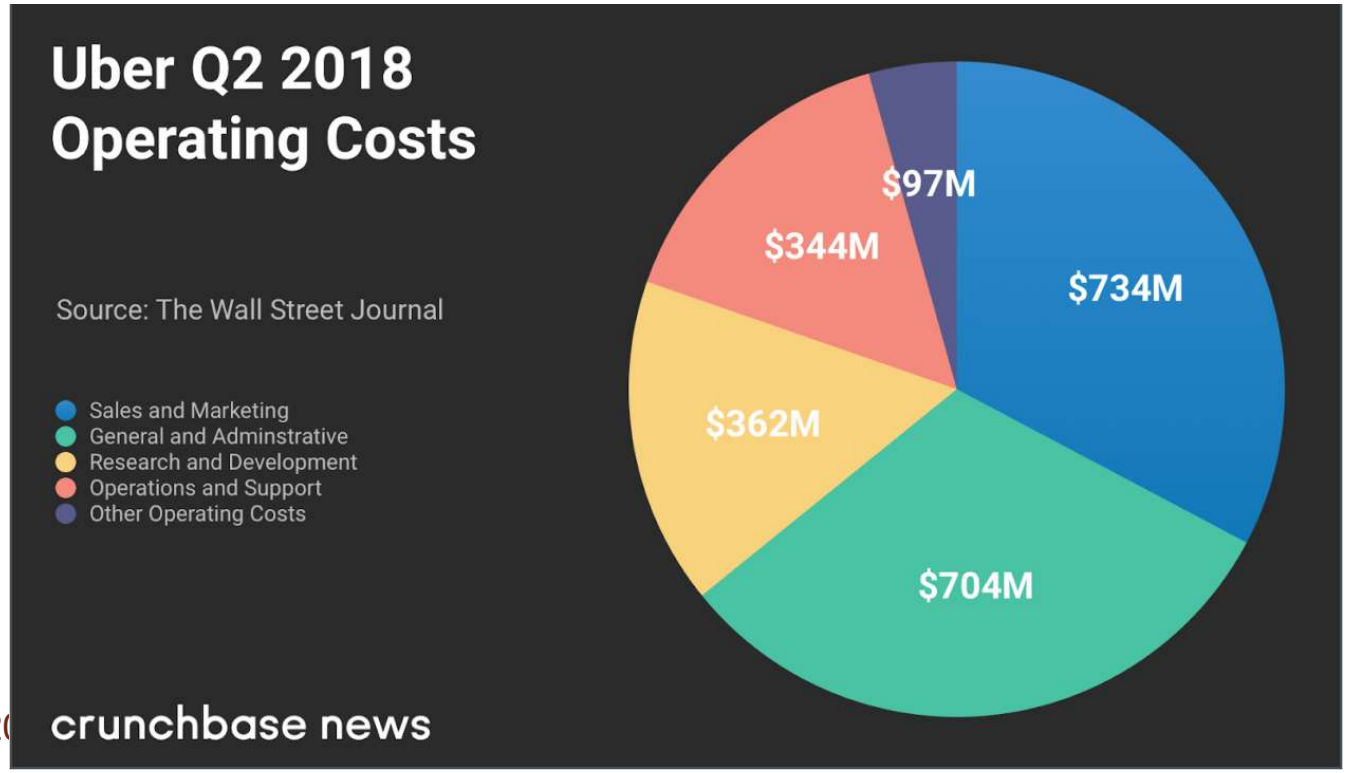
- Other services:

Uber Eats

Uber Freight

Why the losses?

No car fleet, so on what do they spend money?



How to cover the losses?

- On the stock exchange from 2019
- (For the moment) high trust from the marke
  - Attractive (partly false) buzzwords
    - Ridesharing, Green, Smart City, Disruptive
- **Not sustainable** on the long run
- **One of the biggest „bubbles" of our days**
  - The question is just when it will explode

Why is Uber a dumb city application?

- **A „cheap taxi” bad for the city**
  - People use it instead of public transportation
  - Increases the number of cars on the road
  - Increases pollution
  - Around 30% of the traveled distances by Uber vehicles are made empty (no passengers)


THE VERGE TECH REVIEWS SCIENCE CREATORS ENTERTAINMENT VIDEO FEATURES MORE

POLICY TRANSPORTATION UBER

Uber and Lyft finally admit they're making traffic congestion worse in cities

Ride-hailing accounts for up to 14 percent of vehicle miles traveled in some cities, according to a study commissioned by Uber and Lyft

By Andrew J. Hawkins | @andyjayhawk | Aug 6, 2019, 1:33pm EDT

The Uber myth

Uber – smart city or dumb city?

- ✓ Builds on ICT technologies
- ✓ Adaptive mobility service, taking into account the current demand
- ✗ Not energy efficient, increased pollution
- ✗ Not sustainable

waze CARPOOL

- True P2P ridesharing service
- People traveling in the same direction (colleagues) grouped in the same car
- Decreases the number of cars on the roads
- The driver cannot earn money with it, just partly cover its costs
- Only two rides per day

- Started in 2018 – USA, Brazil, Canada, Izrael