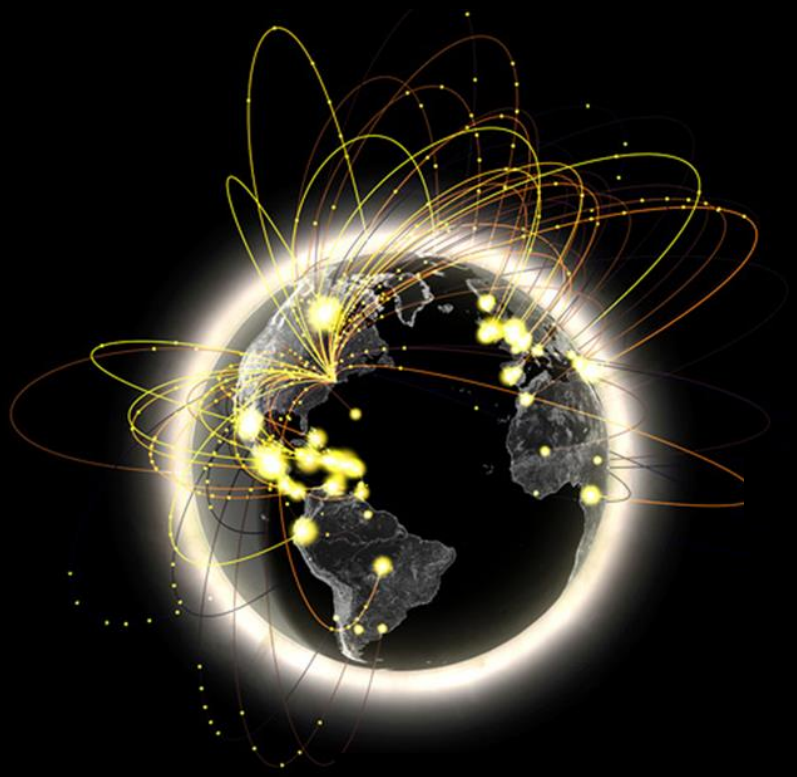

Automated Cars and the Future of Transport

Paolo Santi

senseable city lab:.::

Massachusetts Institute of Technology

MIT Lead, Ambient Mobility Lab

Consiglio Nazionale delle Ricerche


[WE] ARE HERE

Researchers Carlo Ratti (Director), Assaf Biderman (Associate Director), Giovanni Alli, Eric Baczuk, Rex Britter, Andrea Corti, Jennifer Dunnam, Kael Greco, Kristian Kloeckl, David Lee, Claudio Martani, Nashid Nabian, Till Nagel, Otto Ng, Dietmar Offenhuber, Paolo Patelli, Prudence Robinson, Markus Schlapfer, Stefan Seer, Oliver Senn, Stephane Roche, Tony Vanky, Mark Yen

Past Researchers Clio Andris, German W Aparicio Jr., Burak Arikan, Dima Ayyash, Seckin Basturk, Luis Berríos-Negrón, Daniel Berry, Francesco Calabrese, Xiaoji Chen, Carnaven Chiu, Enrico Costanza, Dominik Dahlem, Alyx Daly, Lorenzo Davoli, Talia Dorsey, Sarah Dunbar, Luigi Farrauto, Chris Fematt, Filippo dal Fiore, Lucie Boyce Flather, Saba Ghole, Fabien Girardin, Daniel Gutierrez, Gabriel Grise, Cesar Harada, Guy Hoffman, Anyang Hou, Sonya Huang, Robert Johnson, E Roon Kang, Aaron Koblin, Jan Kokol, Gautier Krings, Sriram Krishnan, Eugene Lee, Xiongjiu Liao, Alyson Liss, Charles Liu, Liang Liu, Giusy Di Lorenzo, Jia Lou, David Lu, Mauro Martino, Andrea Mattiello, Diego Maniloff, Vincenzo Manzoni, Stephen MilesSey Min, Justin Moe, Mahsan Mohsenin, Eugenio Morello, Marina Neophytou, Walter Nicolino, Giovanni de Niederhausern, Christine Outram, James Patten, Francisco Camara Pereira, Santi Phithakkitnukoon, Fabio Pinelli, Riccardo Pulselli, Pietro Pusceddu, François Proulx, Adam Pruden, Rahul Rajagopalan, Martin Ramos, Jon Reades, Bernd Resch, Francisca Rojas, Basant Sagar, Darshan Santani, Aaron Siegel, Luca Simone, Christian Sommer, Susannes Seitinger, Andres Sevtsuk, Louis Sirota, Najeeb Marc Tarazi, Musstanser Tinauli, Vlad Trifa, Andrea Vaccari, Kenny Verbeeck, Nathan Villagaray-Carski, Malima Wolf, Angela Wang, Yao Wang, Sarah Williams, Dustin York, Caitlin Zacharias, Shao Zhou

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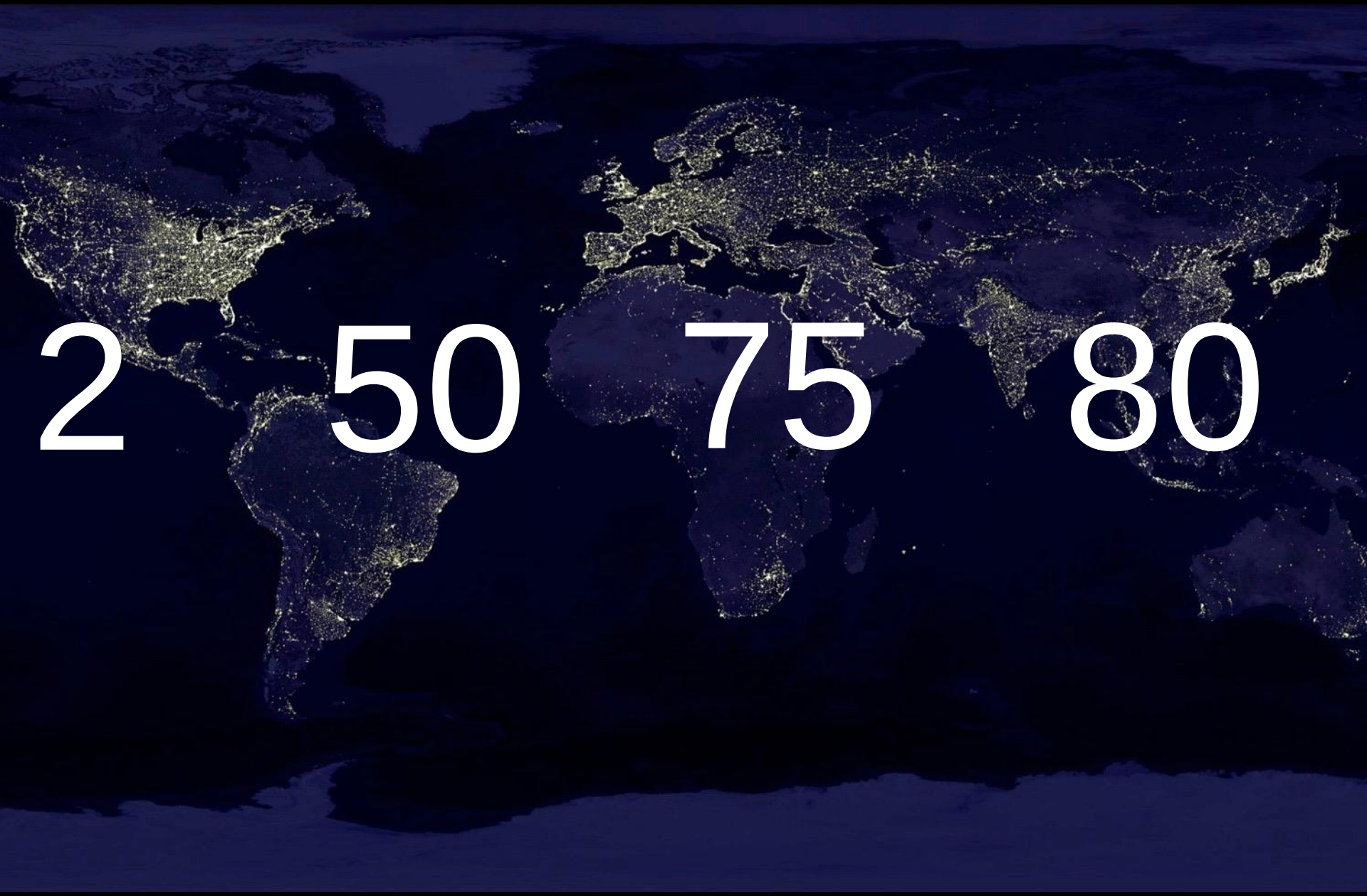
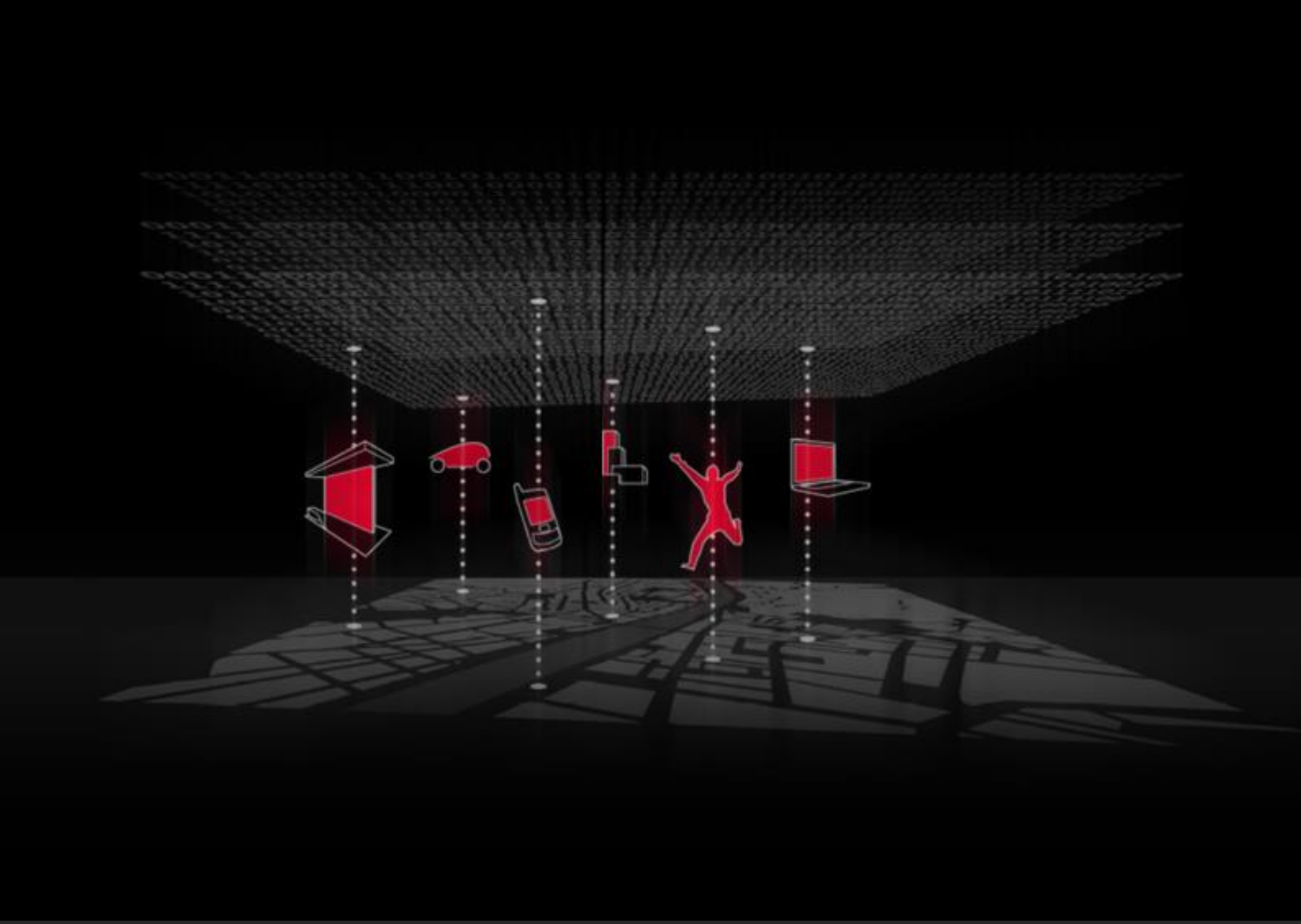

2
50
75
80

big data = everything that can’t fit on an Excel spreadsheet

 - 2003

5 000 000 000 GB

36 hours



Mobility is inefficient

Mobility resources are heavily under-utilized

Most private cars are used less than 10% of the time, and typically by only by the driver
(Mitchell et al 2010)

The average number of passengers on NY Taxis is 1.32
(NY Taxi Limousine Commission 2014)

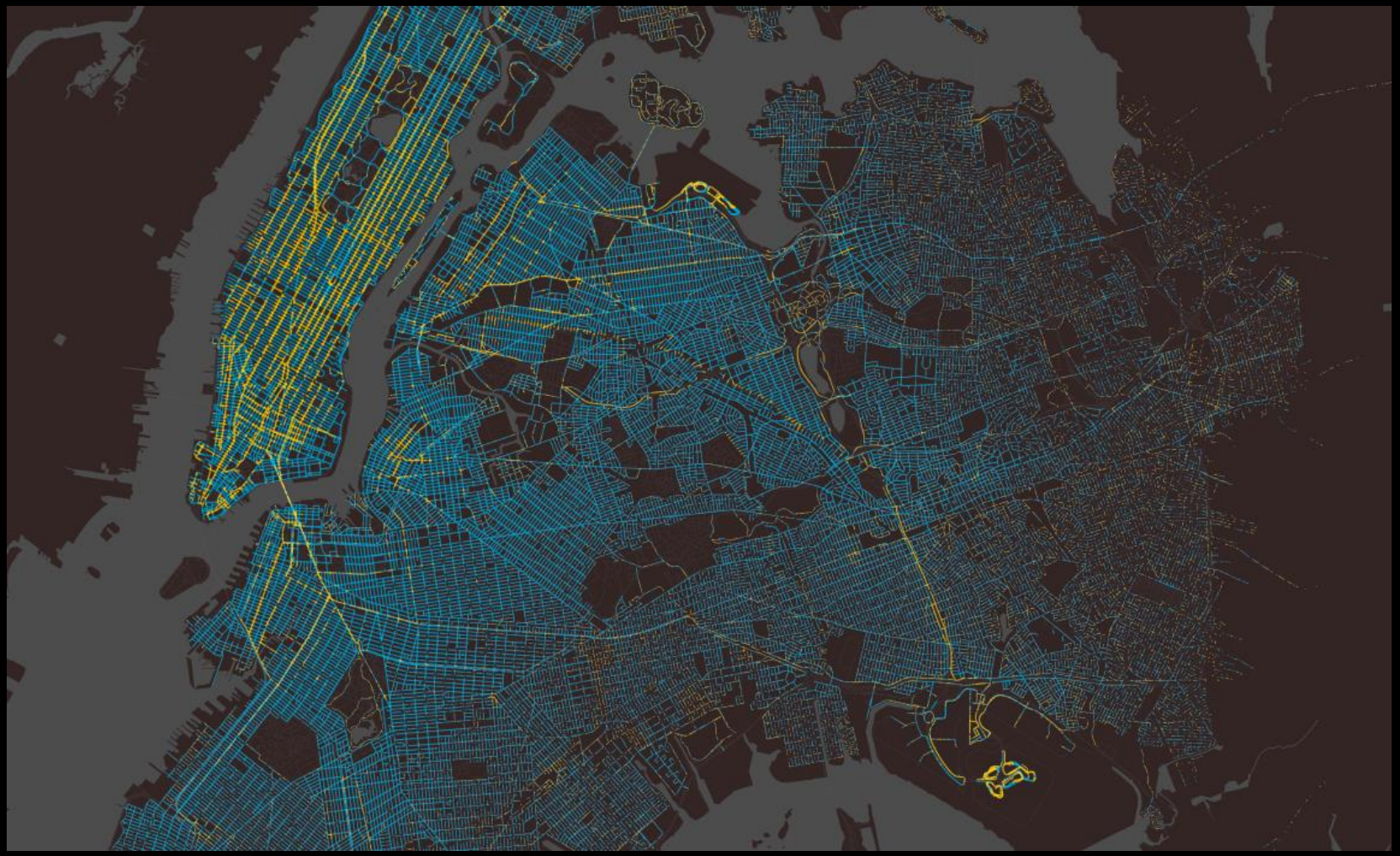
HUBCAB

Taxi-sharing in New York City: A network-based approach

MIT Senseable City Lab

HUBCAB

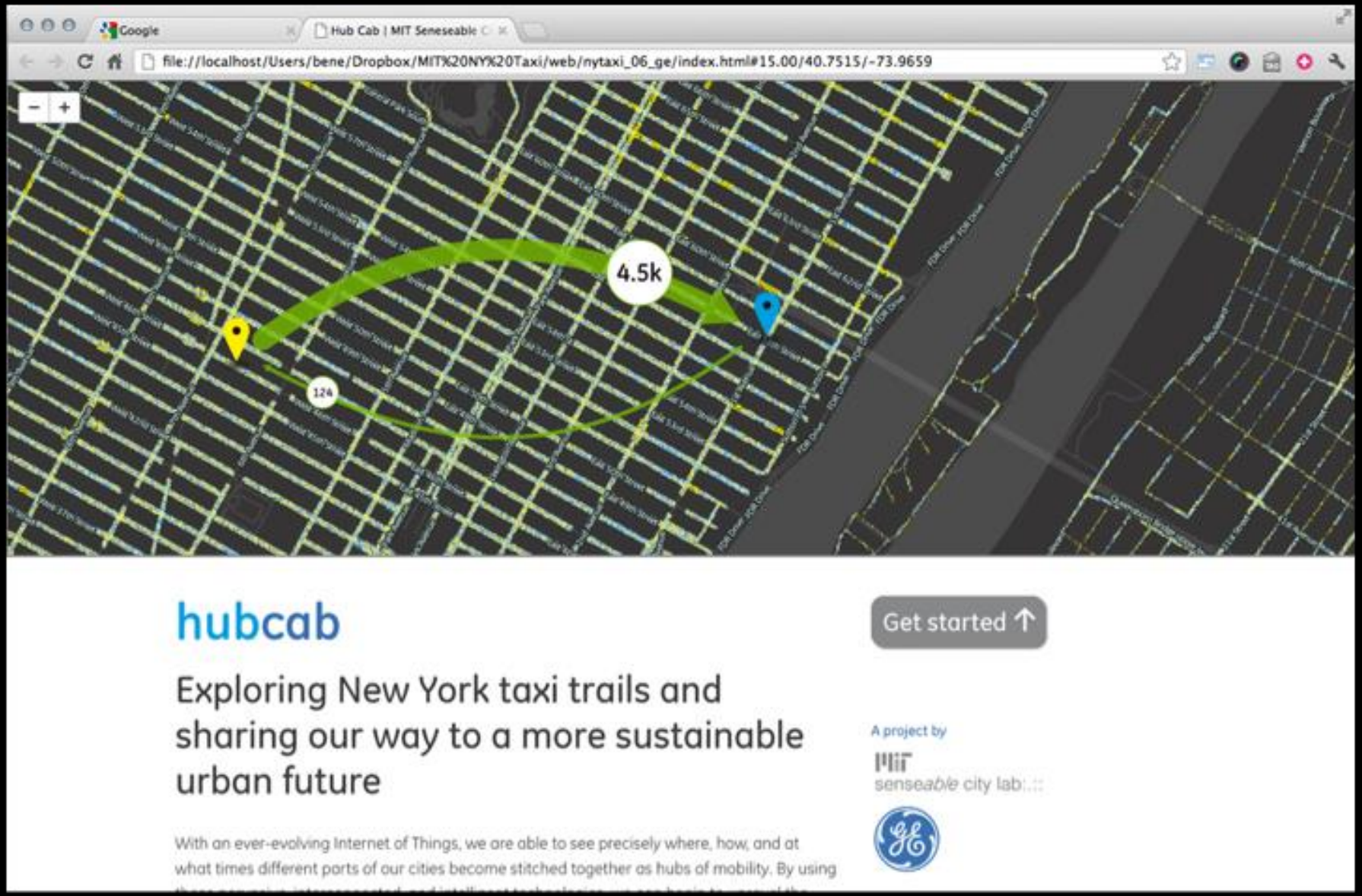
NYC taxi trips in 2011



13500 cabs
150 million trips ~400.000 per day

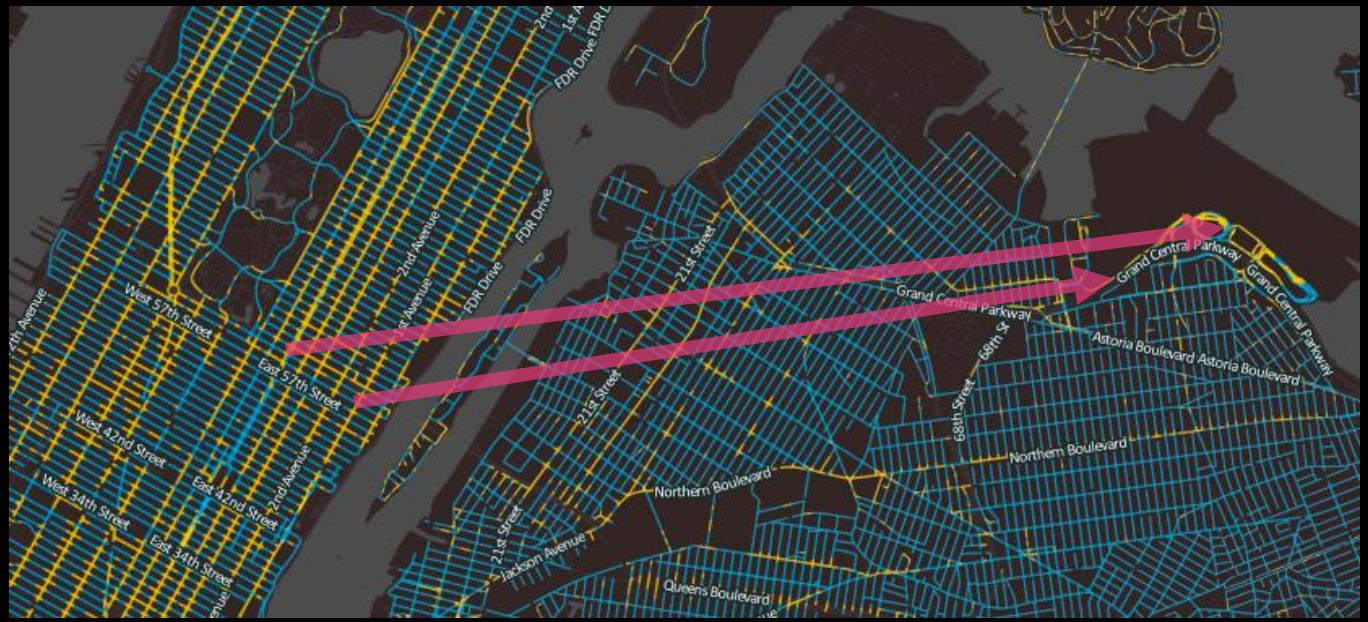
Pickups Dropoffs

HubCab


Google
Hub Cab | MIT Senseable
file://localhost/Users/bene/Dropbox/MIT%20NY%20Taxi/web/nytaxi_06_ge/index.html#15.00/40.7515/-73.9659
4.5k
124
hubcab
Exploring New York taxi trails and sharing our way to a more sustainable urban future
With an ever-evolving Internet of Things, we are able to see precisely where, how, and at what times different parts of our cities become stitched together as hubs of mobility. By using
Get started
A project by
MIT
senseable city lab

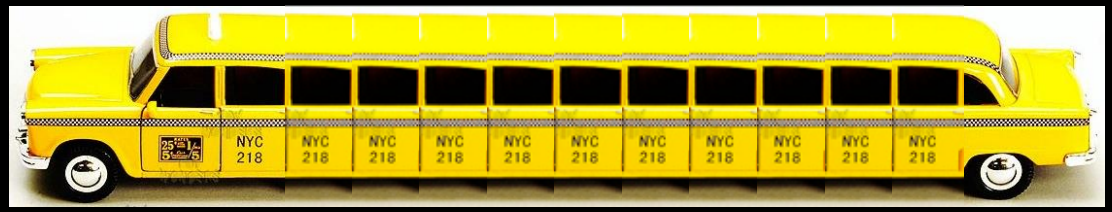
Sharing two trips

Combine 2 trips

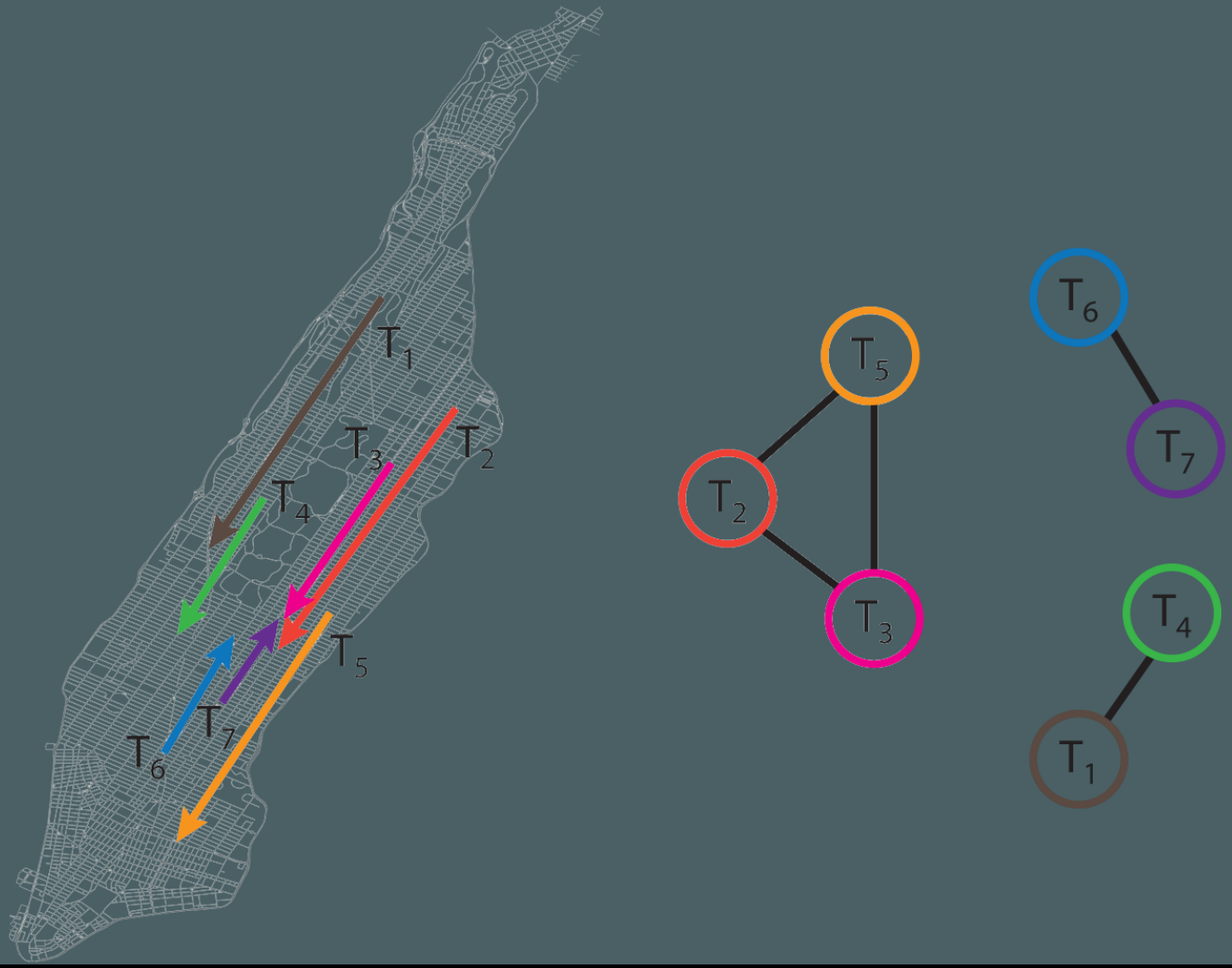


..and even more trips!

Combine k trips



Shareability networks



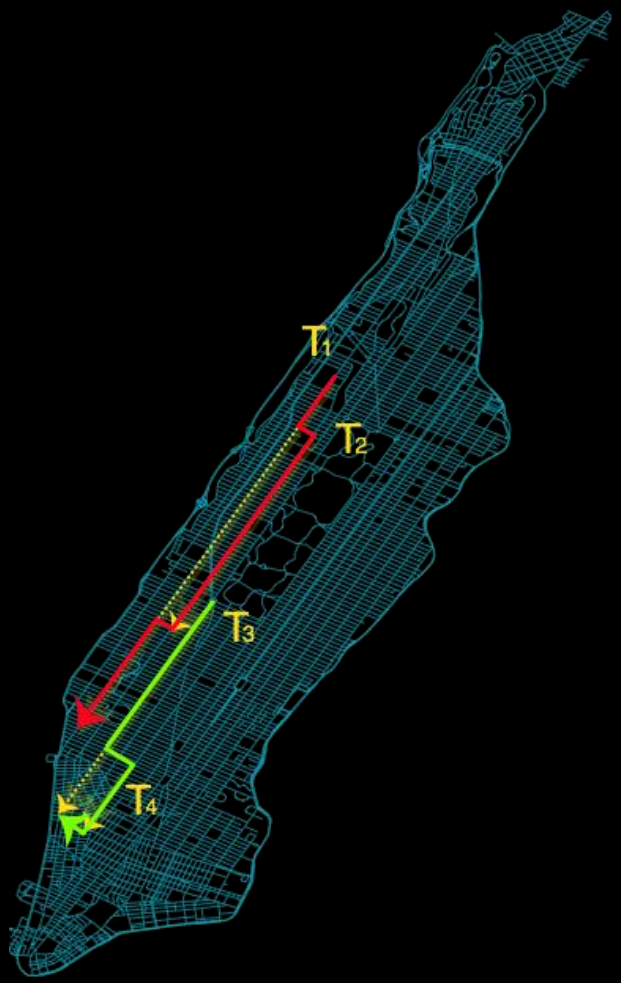
Shareability condition

4 possible routes

Shareable

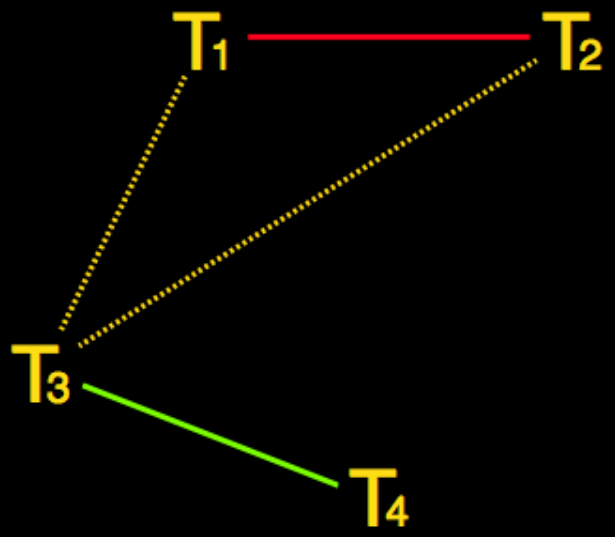
delay constraint Δ satisfied for at least one route

Maximum matching



# of rides
k = 2

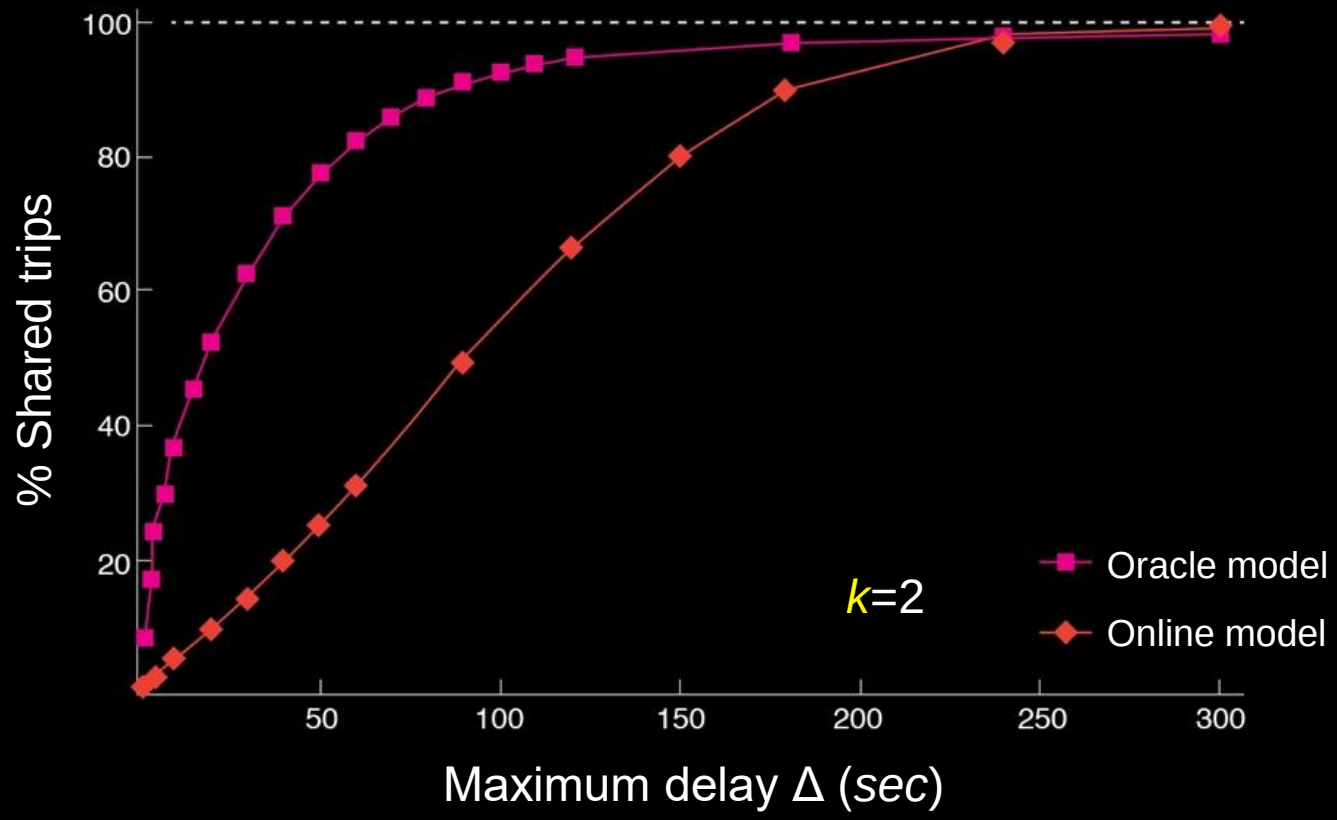
Maximum matching
Generalizable to *k* > 2
but unfeasible for *k* > 3



Chandra and Halldorsson, J Alg 39 (2001)

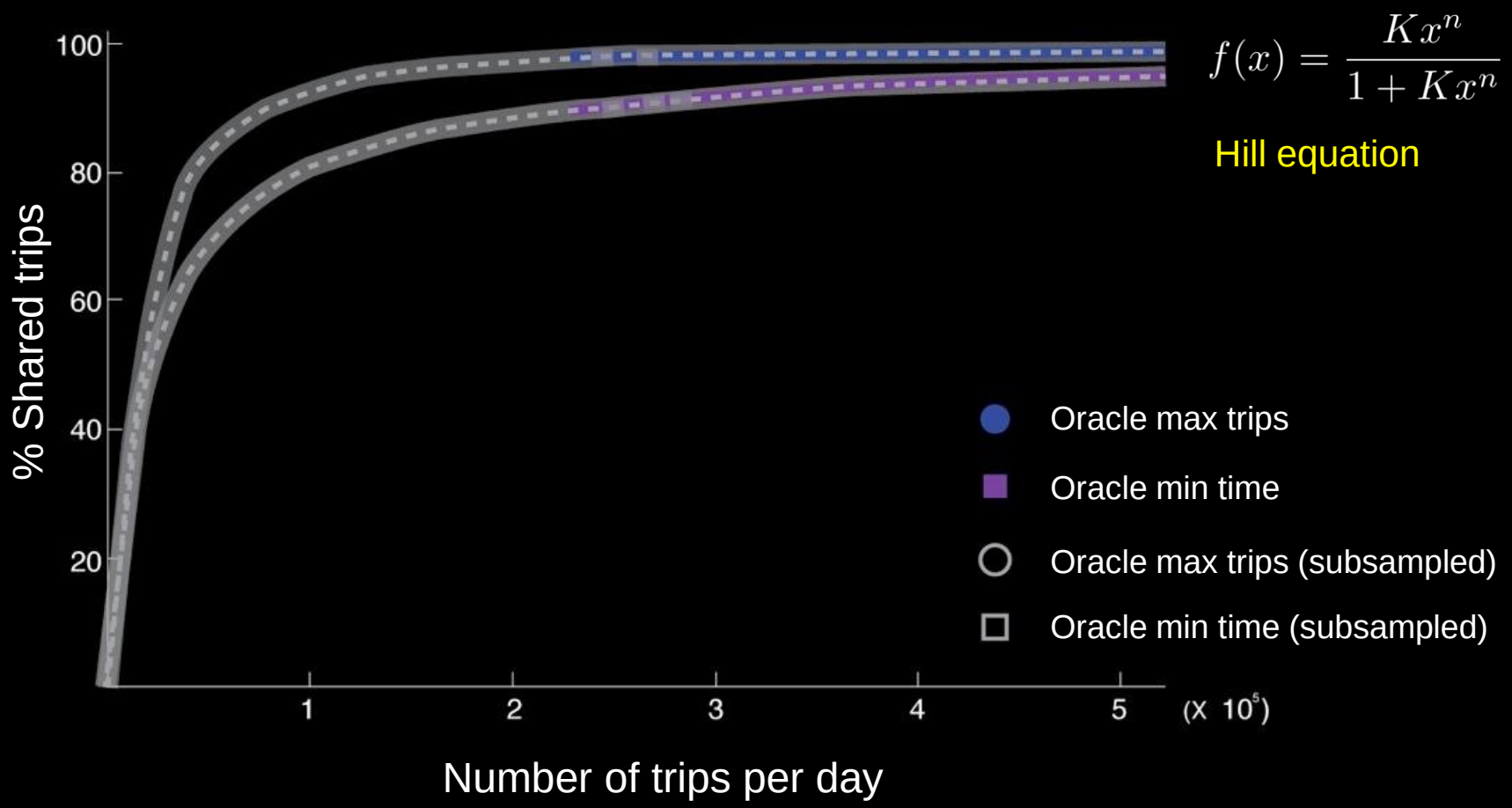
The majority of trips are shareable!

The majority of trips is shareable with minimal passenger inconvenience



HubCab in less dense cities

Results can be generalized to less dense cities or to low market penetration

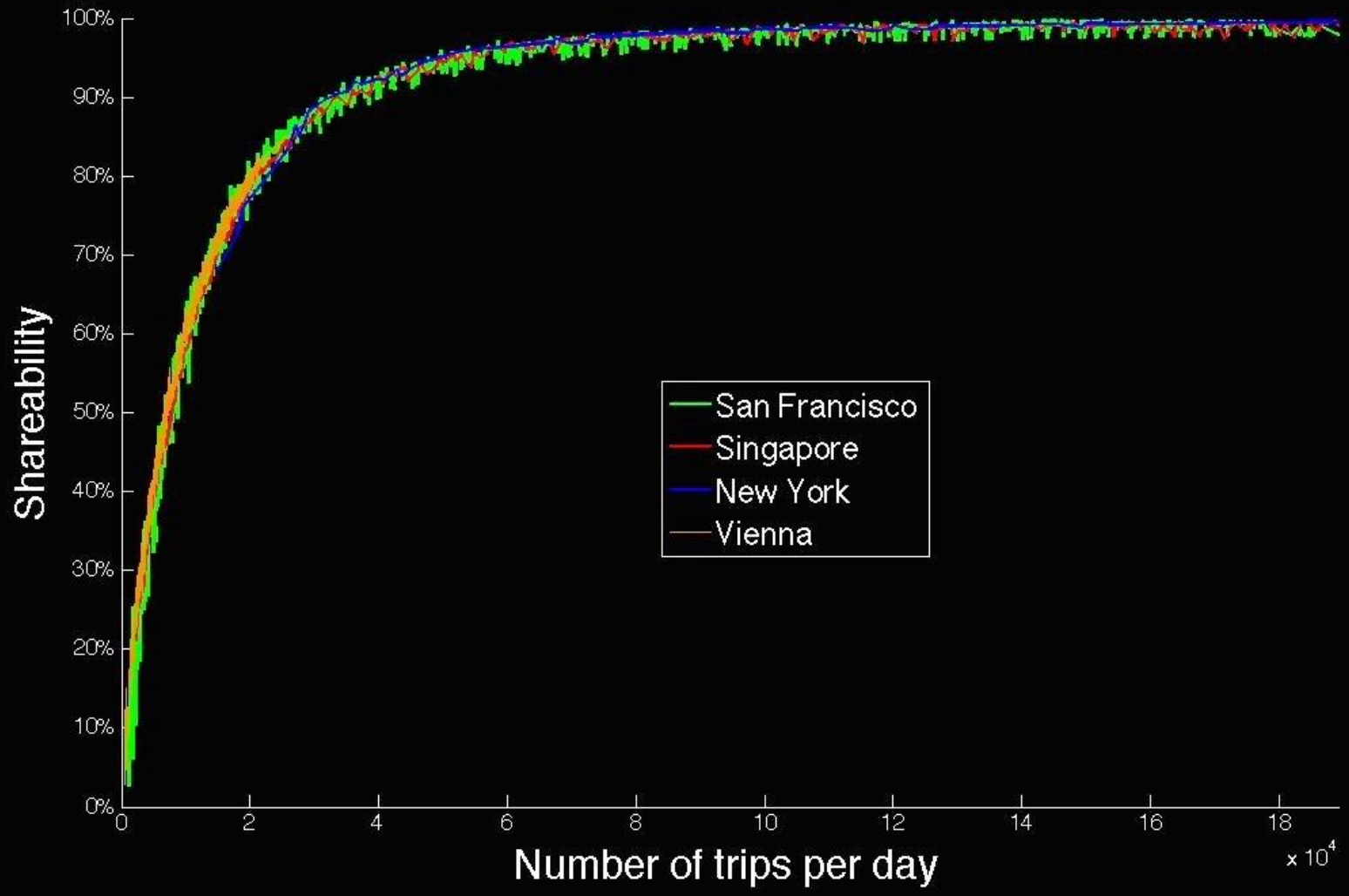


$$f(x) = \frac{Kx^n}{1 + Kx^n}$$

Hill equation

Hill, J Physiol 40 (1910)

Shareability in other cities



Can we model shareability?

Input:

- trip generation rate λ
- Average car speed v
- Delay tolerance Δ
- City area A

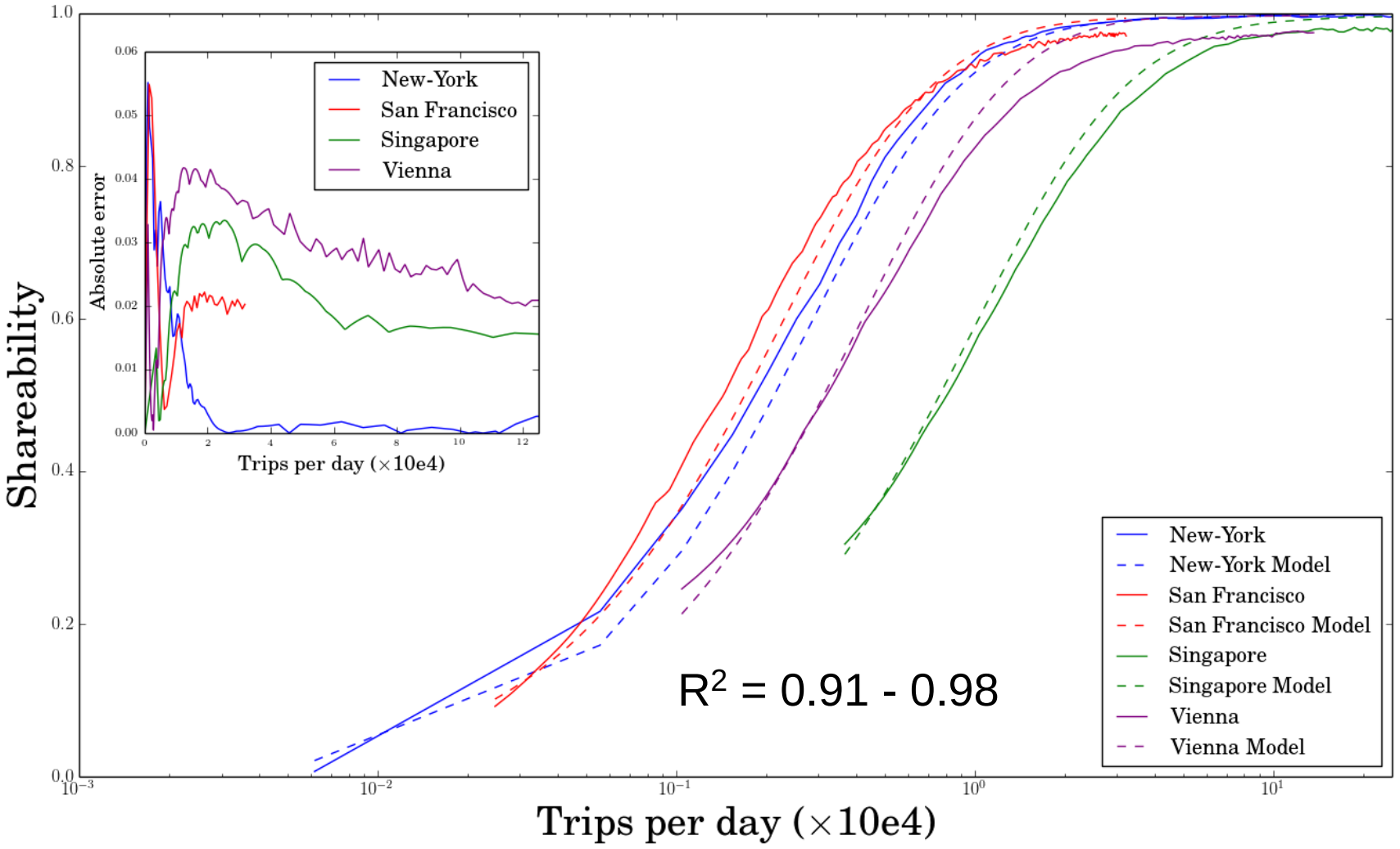
Output:

- percentage S of shareable trips

$$s \propto \frac{\lambda \cdot \Delta^3 \cdot v^2}{A}$$

Shareability shadow

Shareability model accuracy



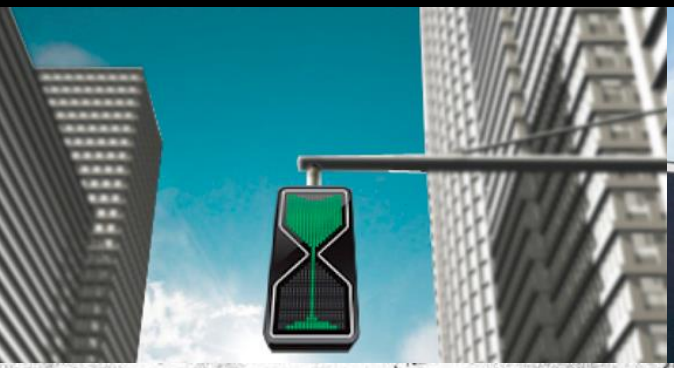
Light Traffic

Improving traffic efficiency through slot-based intersections

DriverlessCities: prediction

Traffic lights

Traffic lights are 150 years old technology, conceived for horses

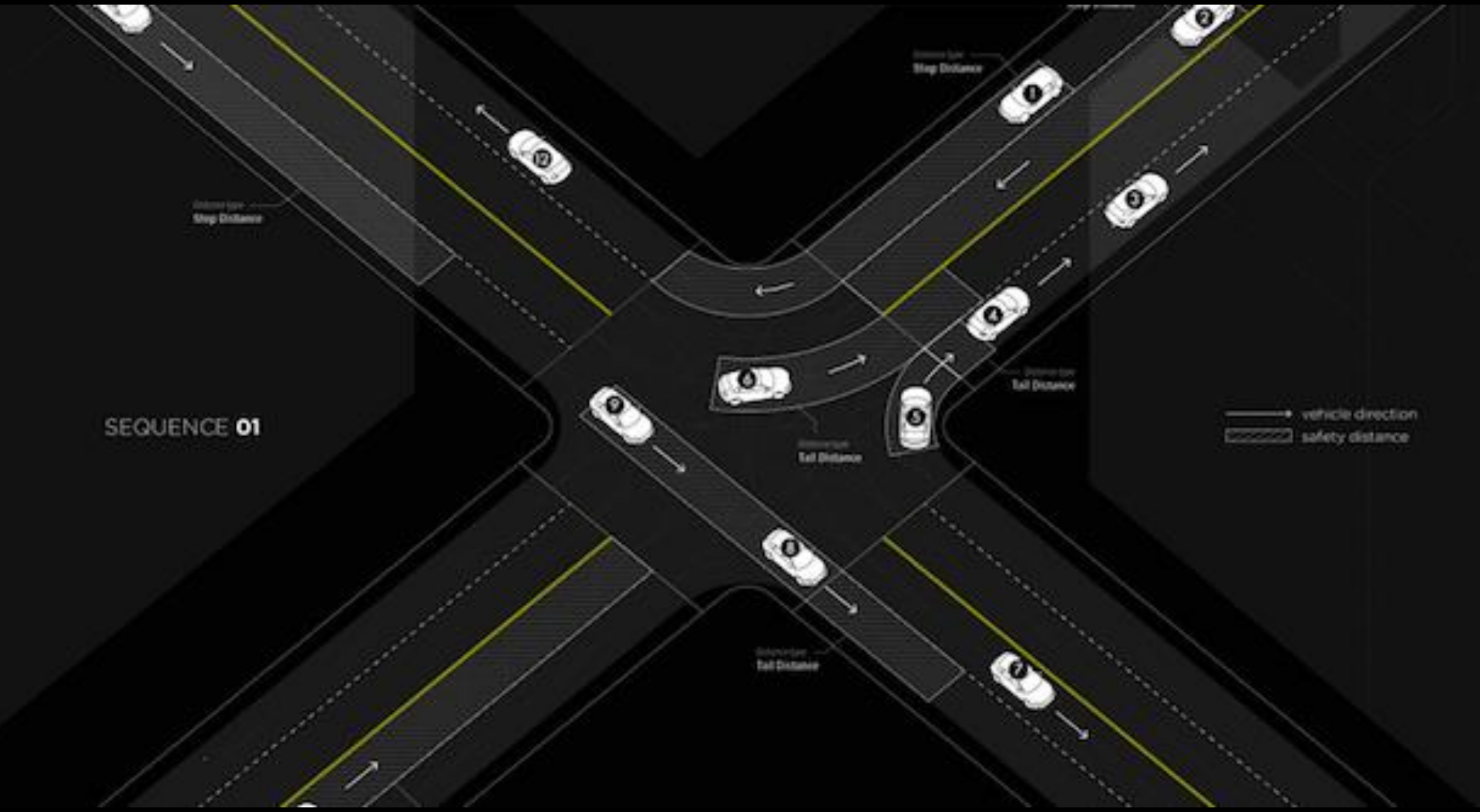


The death of traffic lights?

Driverless vehicles will just optimize traffic light operation (modern horses), or can we do something better?

Slot-based intersection

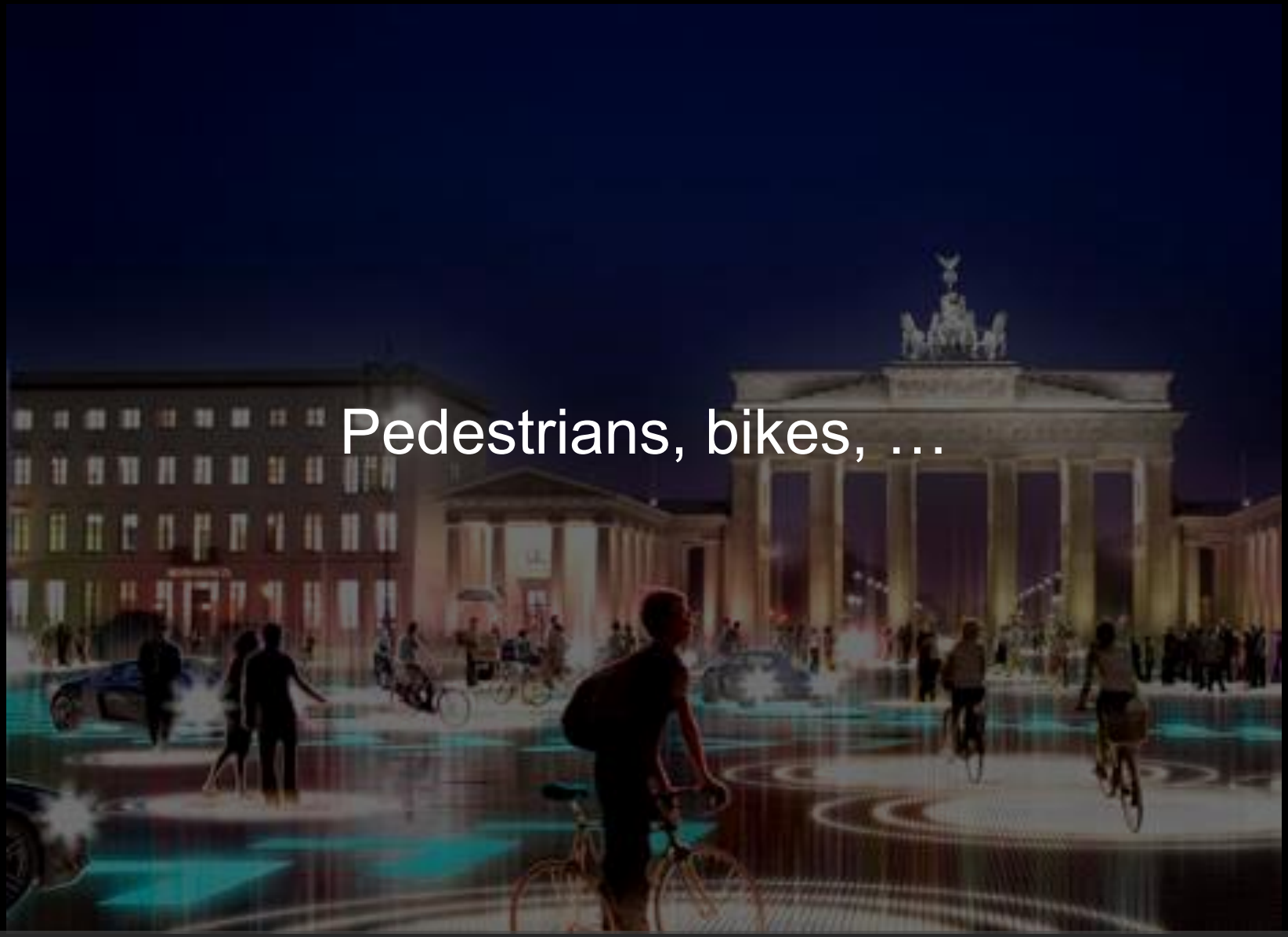
From flow-based to vehicle-based intersection management



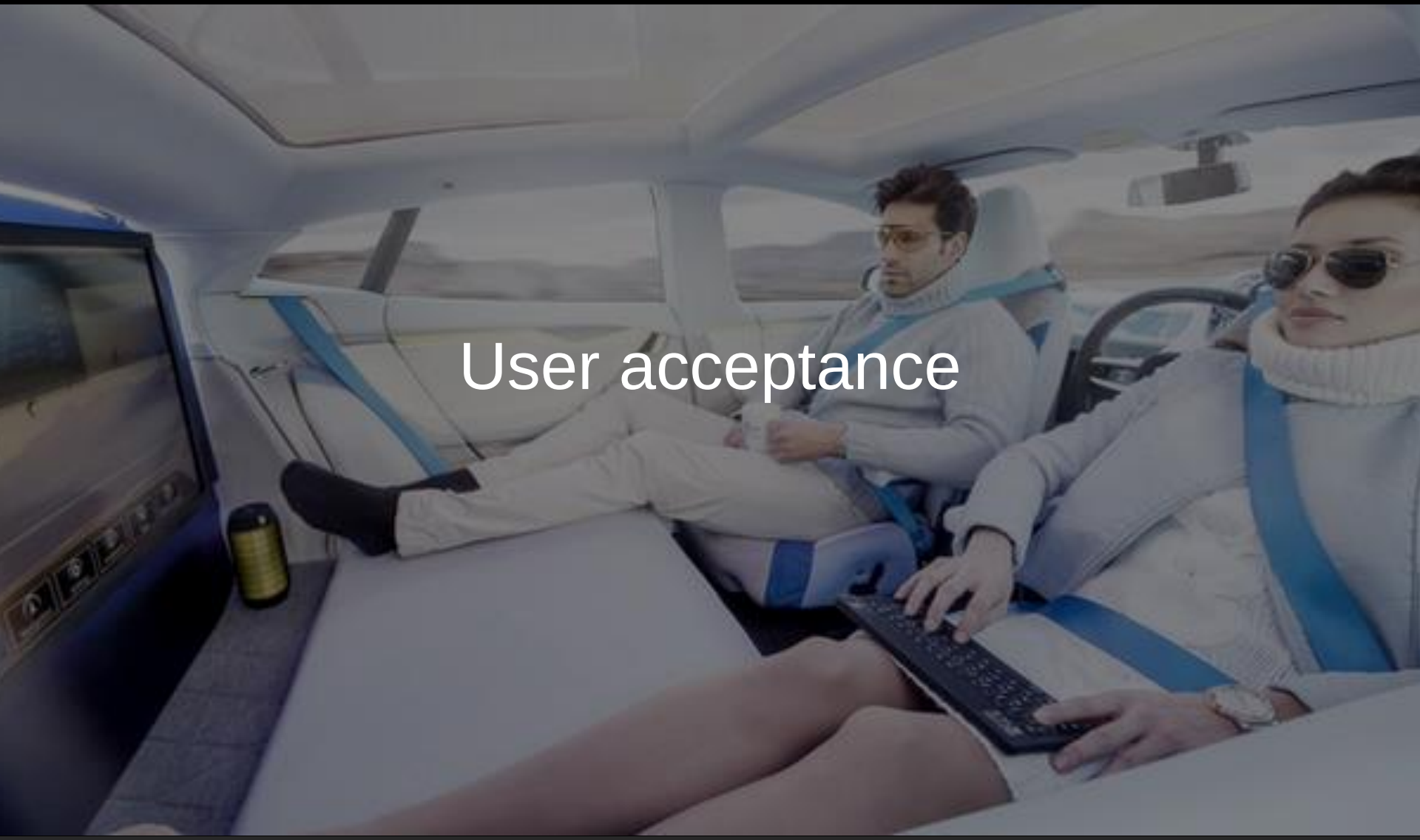
Light Traffic

Double intersection capacity vs. traffic light: with current traffic, queues would disappear

Challenges



Challenges

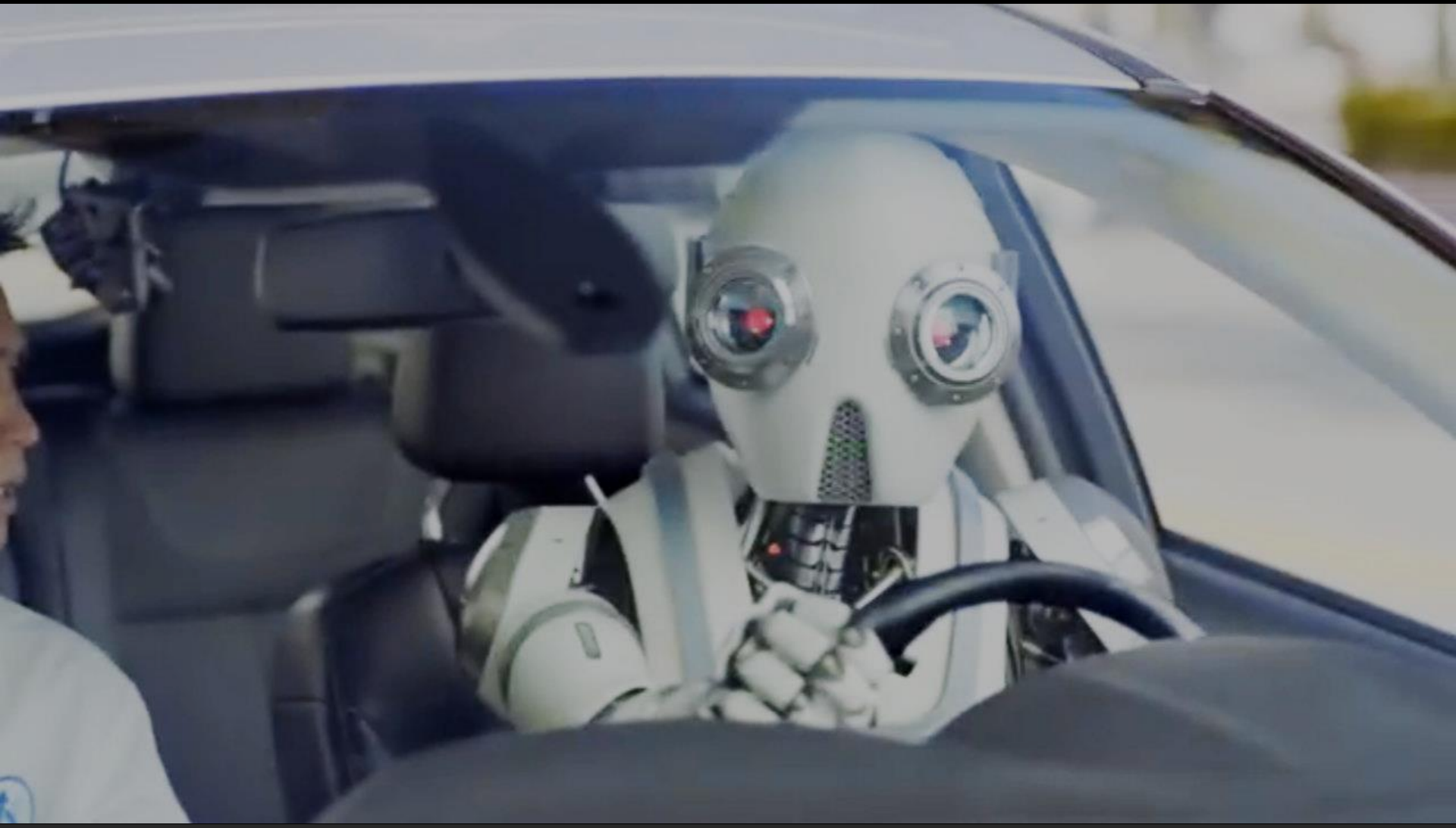


Challenges

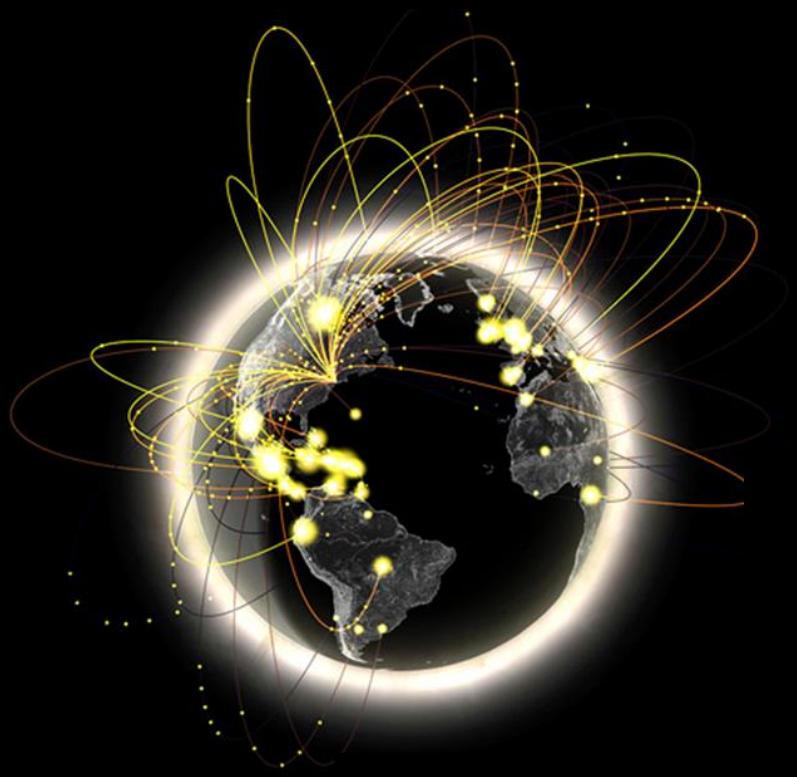
Ownership model: family car, urban fleet, corporate fleet,…

Challenges

Liability: who is responsible for (hopefully less likely!) accidents?



Automated warehouse?



Thank you!

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