

# Urban data analysis - projects, methods and tools used to describe 21st century cities

oliver senn

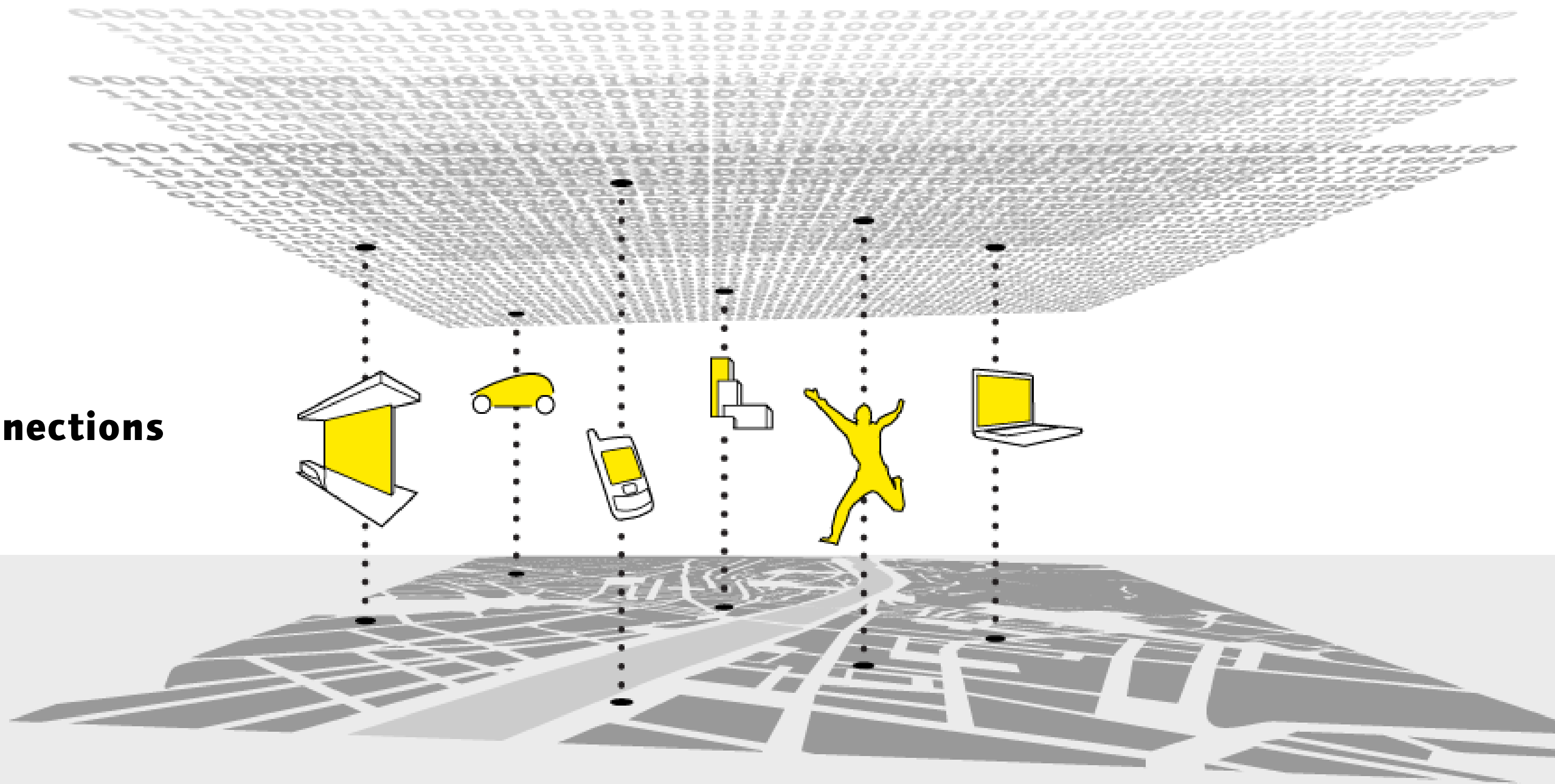
*senseable* city lab, massachusetts institute of technology  
singapore-mit alliance for research and technology

26 october 2011 | hpts 2011, monterey

## **cities**

host over 50% of the world's population  
cover 2% of the earth's crust  
account for 75% of energy consumption  
emit 80% of manmade CO<sub>2</sub>

**connections**



**rethinking in a creative way the interface  
between people, mobile technology and the city**







Afian Anwar

Eric Baczuk

Assaf Biderman

Rex Britter

Franscesco Calabrese

Andrea Cassi

Xiaoji Chen

Dominik Dahlem

Jennifer Dunnam

Paula Echeverri

Alexandre Gerber

Myshkin Ingawale

E Roon Kang

Ari Kardasis

Kristian Kloeckl

David Lee

David Lee

Diego Maniloff

Vincenzo Manzoni

Sey Min

Christine Outram

DeDe Paul

Christoper Rath

Carlo Ratti

James Rowland

Darshan Santani

Aaron Siegel

Christian Sommer

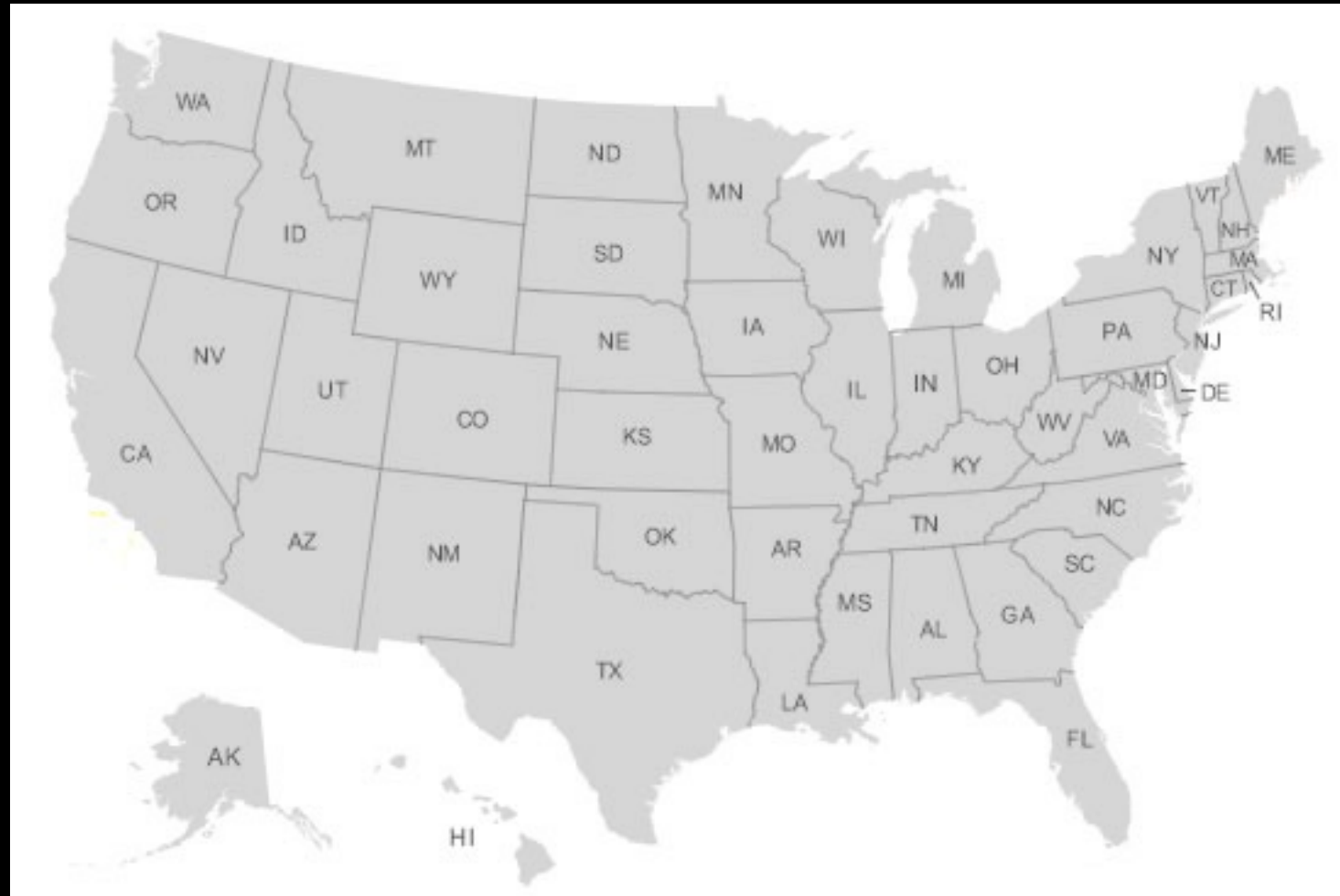
Nathan Villagaray-Carski

Mark Yen

Dustin York

# Connected States of America

How do people connect  
to each other in the  
United States and do  
connected communities  
reflect political  
boundaries?





## **Data source: Telecommunication Call Data Records**

- July 2010 data
- Millions of phone users (US)
- Caller, callee
- Length of call
- Location (city, district, cell tower) for both caller, callee



# **copenhagen wheel**



# Copenhagen: city of bikes

today:

**37%** bike commuting

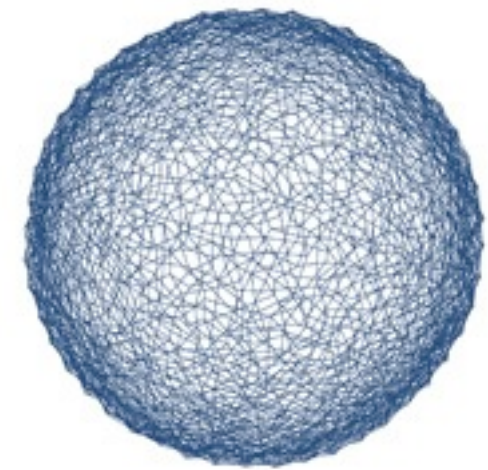
**350 km** bike paths

objective 2015:

**50%** bike commuting

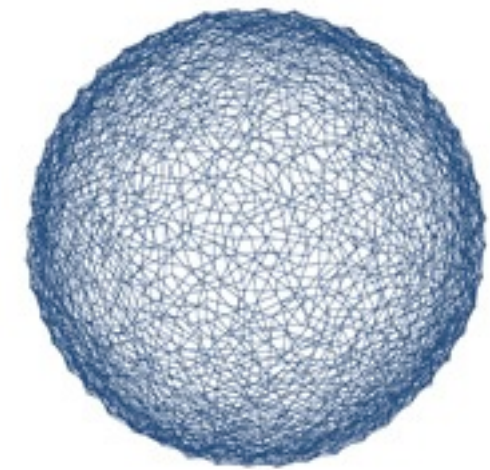
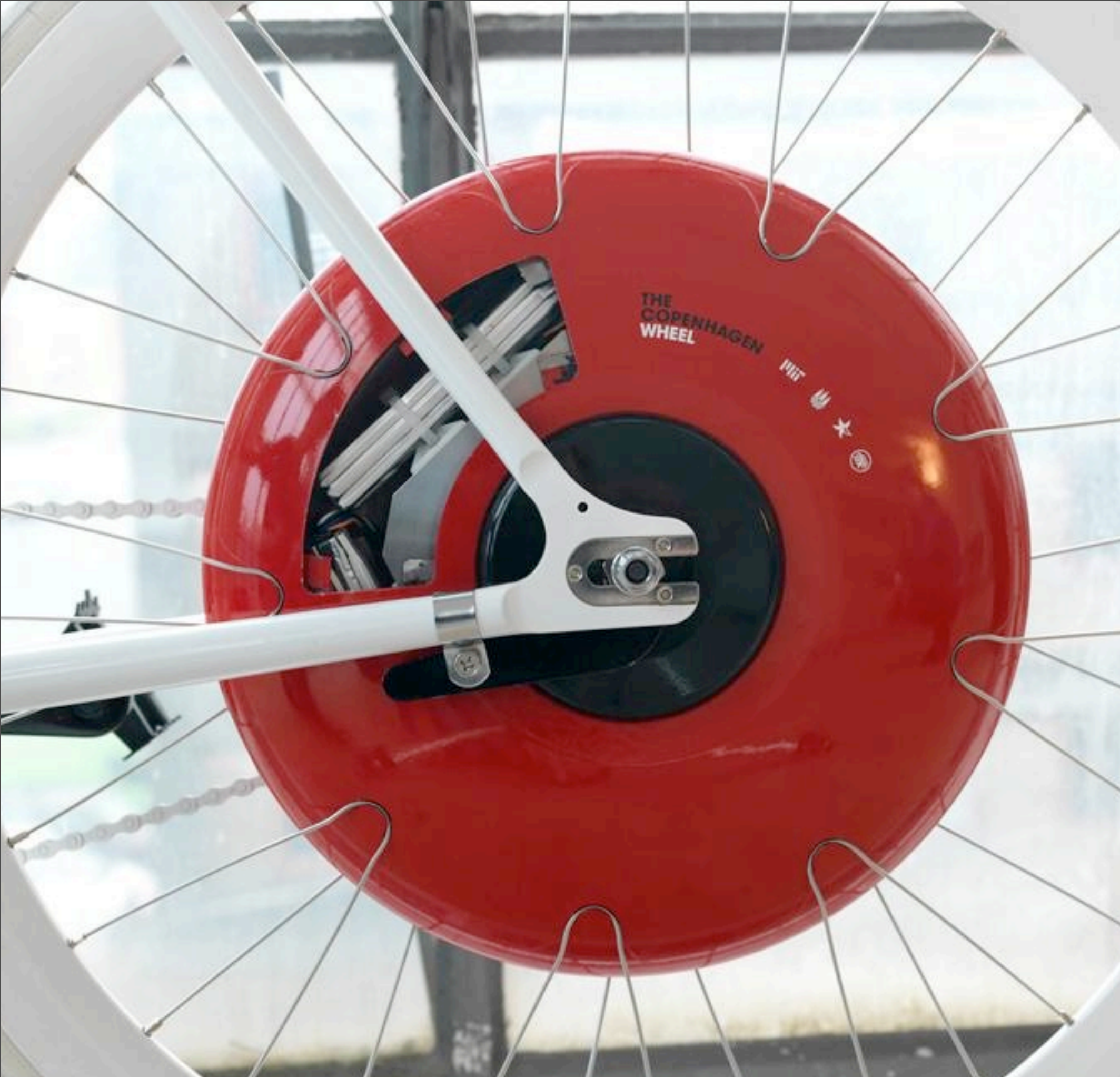






COP15  
COPENHAGEN  
UNITED NATIONS CLIMATE CHANGE CONFERENCE 2009

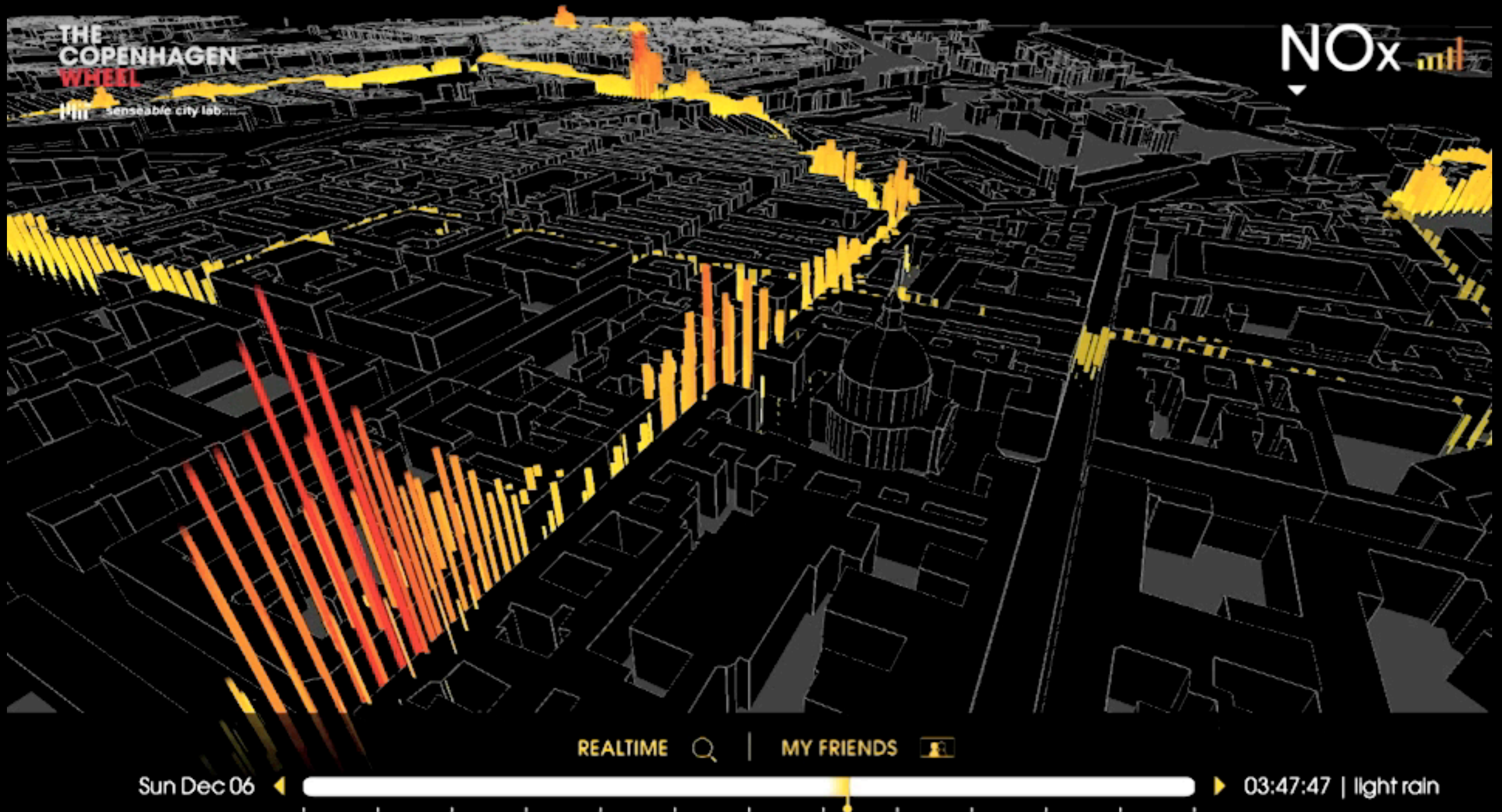




COP15  
COPENHAGEN  
UNITED NATIONS CLIMATE CHANGE CONFERENCE 2009







gaining access to a larger pool of information

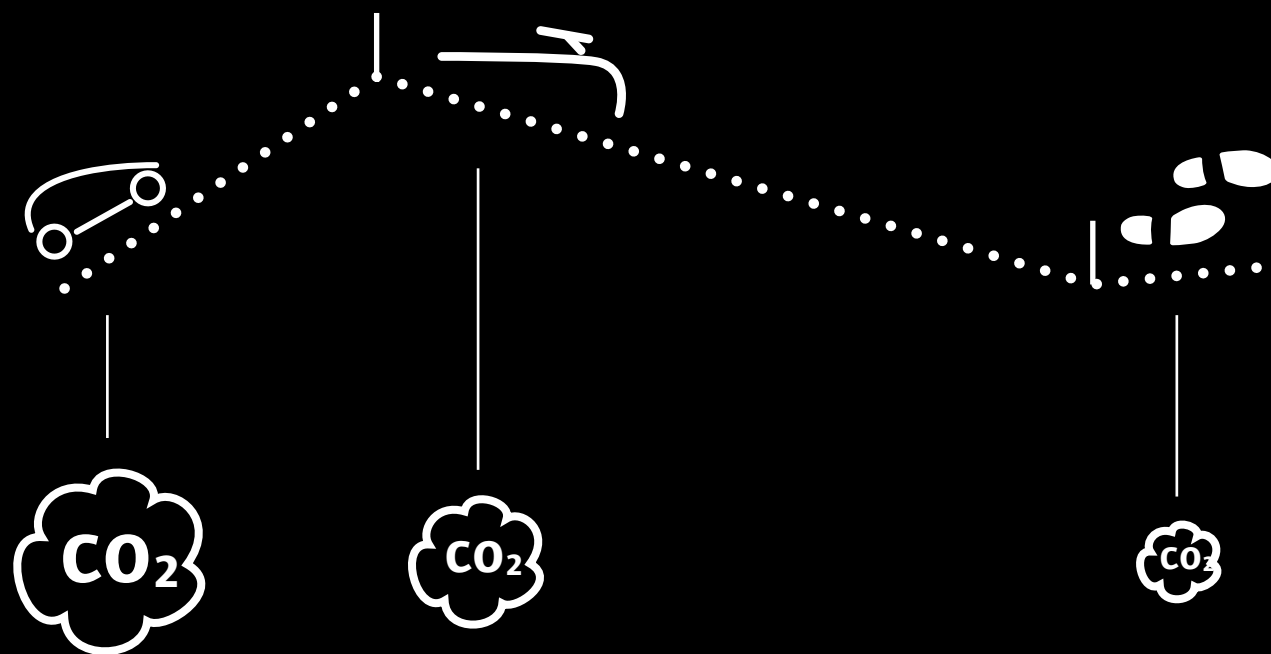
**co2go - from potholes to...**



**more than a third of global  
CO<sub>2</sub> emissions are generated  
by transportation**



how to provide people with  
**feedback** on ones own impact on  
emissions **in real time** and with **no**  
**user input** required?



well...  
many of us carry  
**smartphones** in  
our pockets, and  
they contain a  
**variety of sensors**



## accelerometer traces for distinct transportation modes

bus

walking

biking

metro



## user interface



The user's travel mode is determined and visualized top right to provide feedback about the correct functioning. Travel time, distance covered and associated CO2 emissions are updated in real-time together with a map view of the user's route.



The "city" view provides insight in how the user's carbon emissions and travel distance compare to his fellow citizen's total and average values, enabling him, among others, to identify whether her contributes to an increase or decrease in average CO2 emissions.



Within the "share" screen a user can give others access to select travel routes and their emissions as well as being able to consult other user's low emission routes, tapping into a collective effort to reduce CO2 emissions generated by urban mobility.





# **real-time urban data**





# Venice Architecture Biennale 2006

Wednesday, October 26, 2011



# Connectivity: Is public transportation where the people are?



REAL TIME 12:56

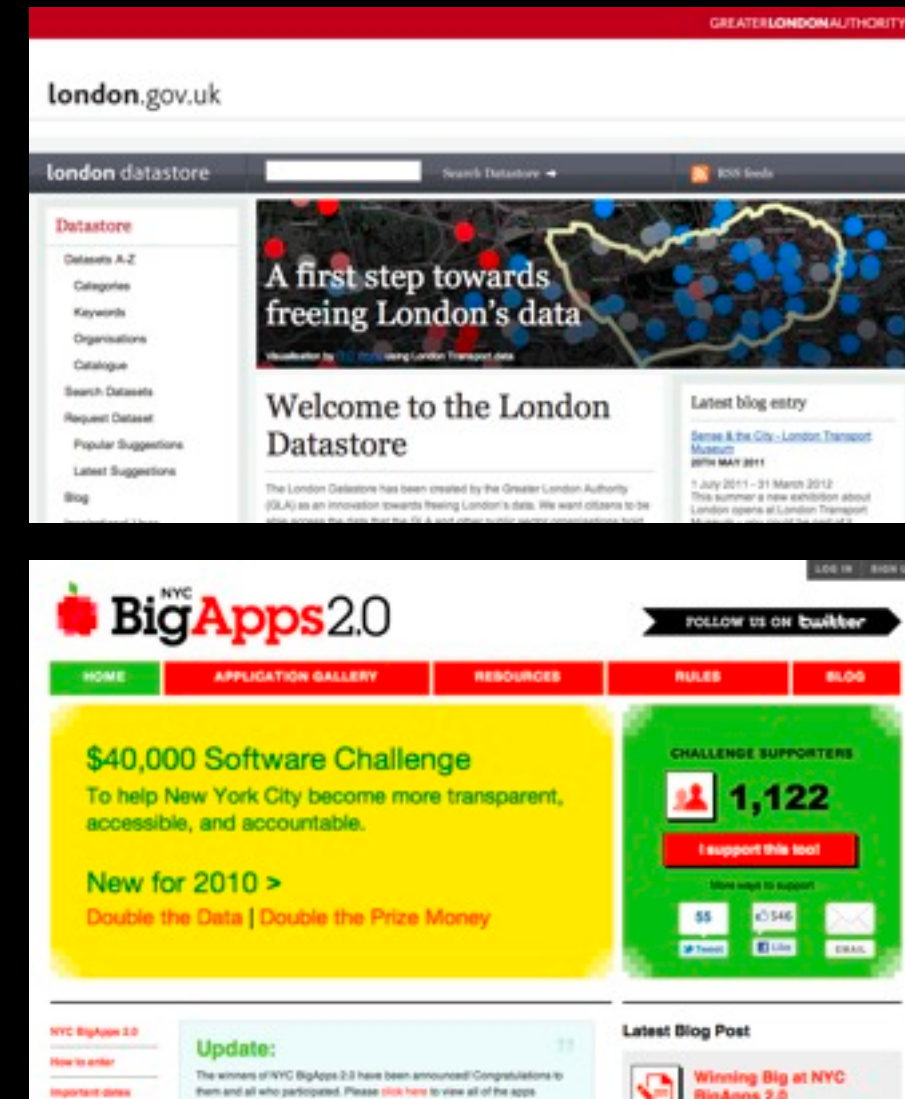
low high

Wednesday, October 26, 2011



**LIVE Singapore!**





**LIVE Singapore!**

**from:  
open platform for  
historic data**

# **LIVE Singapore!**

**from:**  
**open platform for**  
**historic data**



**to:**  
**open platform for**  
**real-time data**

# real time data for sync'ed feedback loop

bringing data back to the city

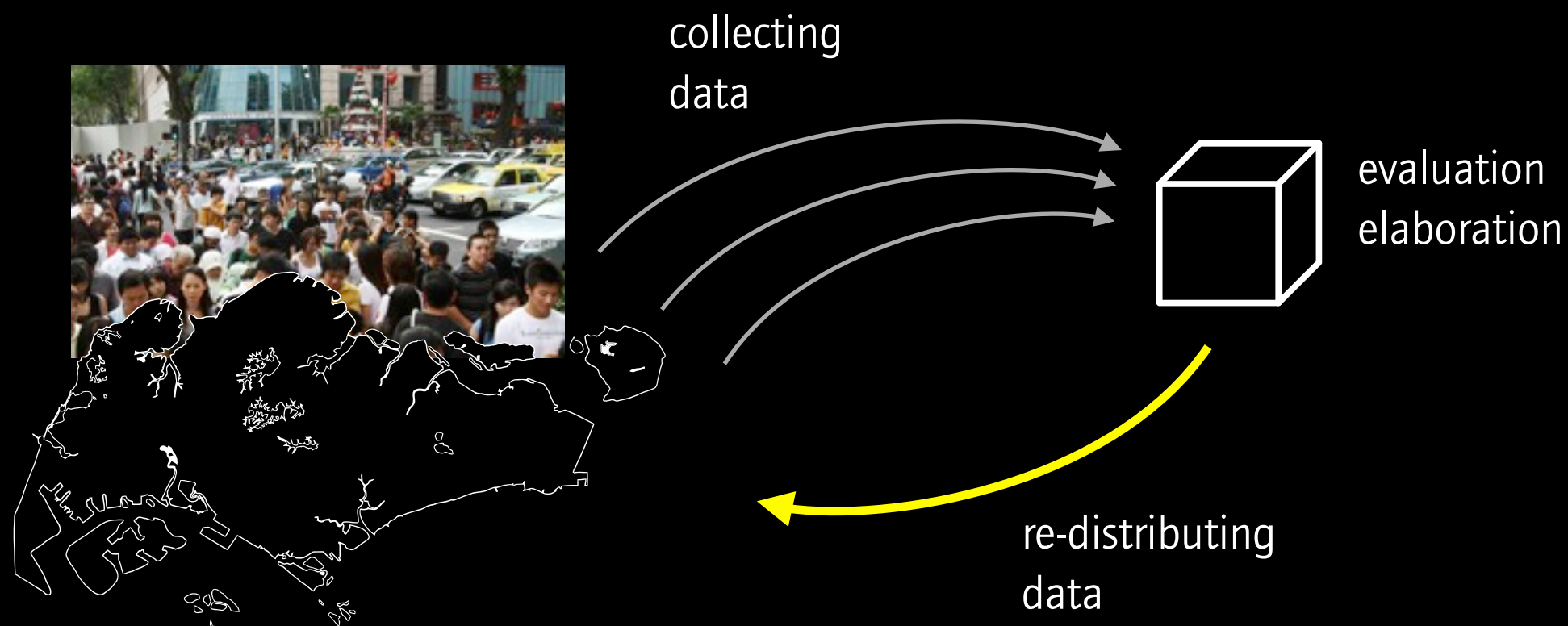
the real-time map



the real city



# data collection/ combination/ distribution

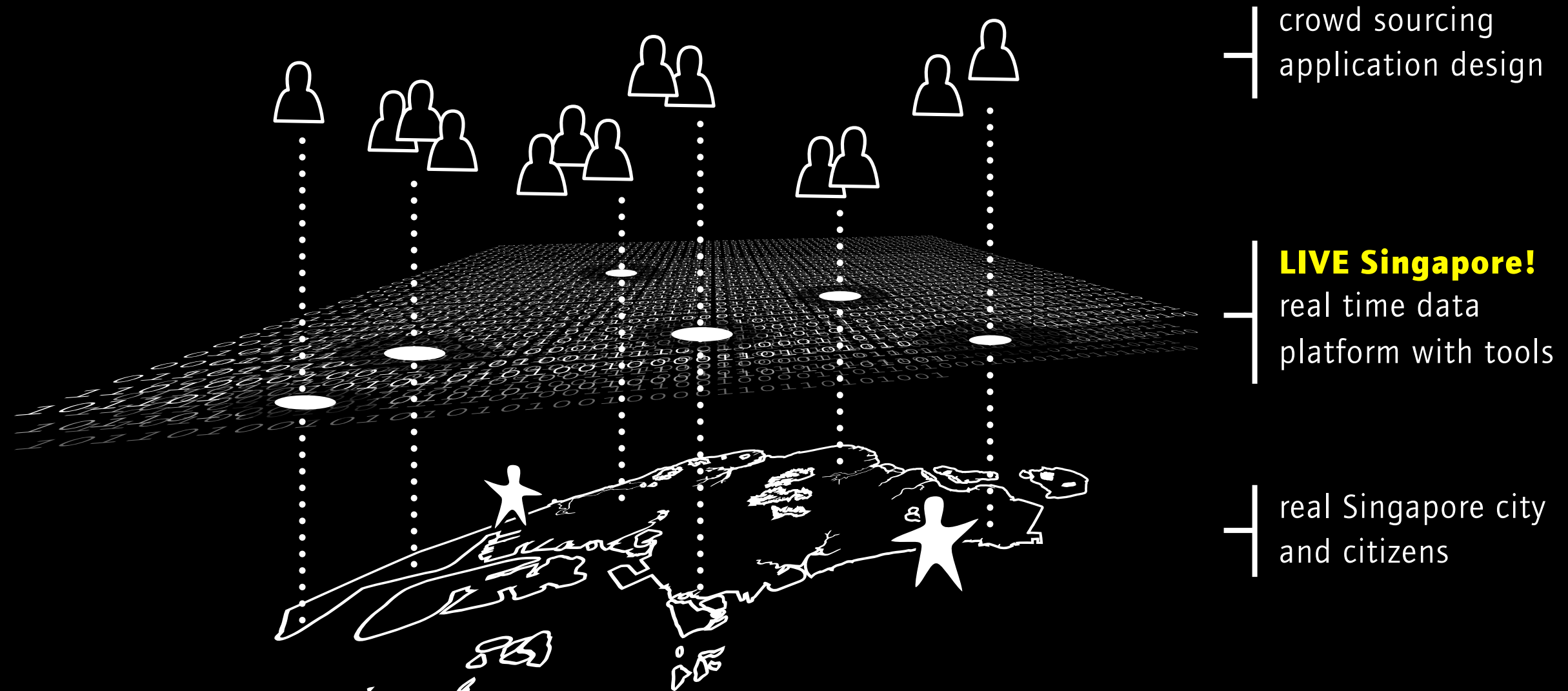




# **visualization / tangibilization of data**

turning data into meaningful instruments





LIVE Singapore is no single one application but  
an **enabling platform** for applications



# LIVE Singapore! exhibition

SAM | Singapore Art Museum | April 2011



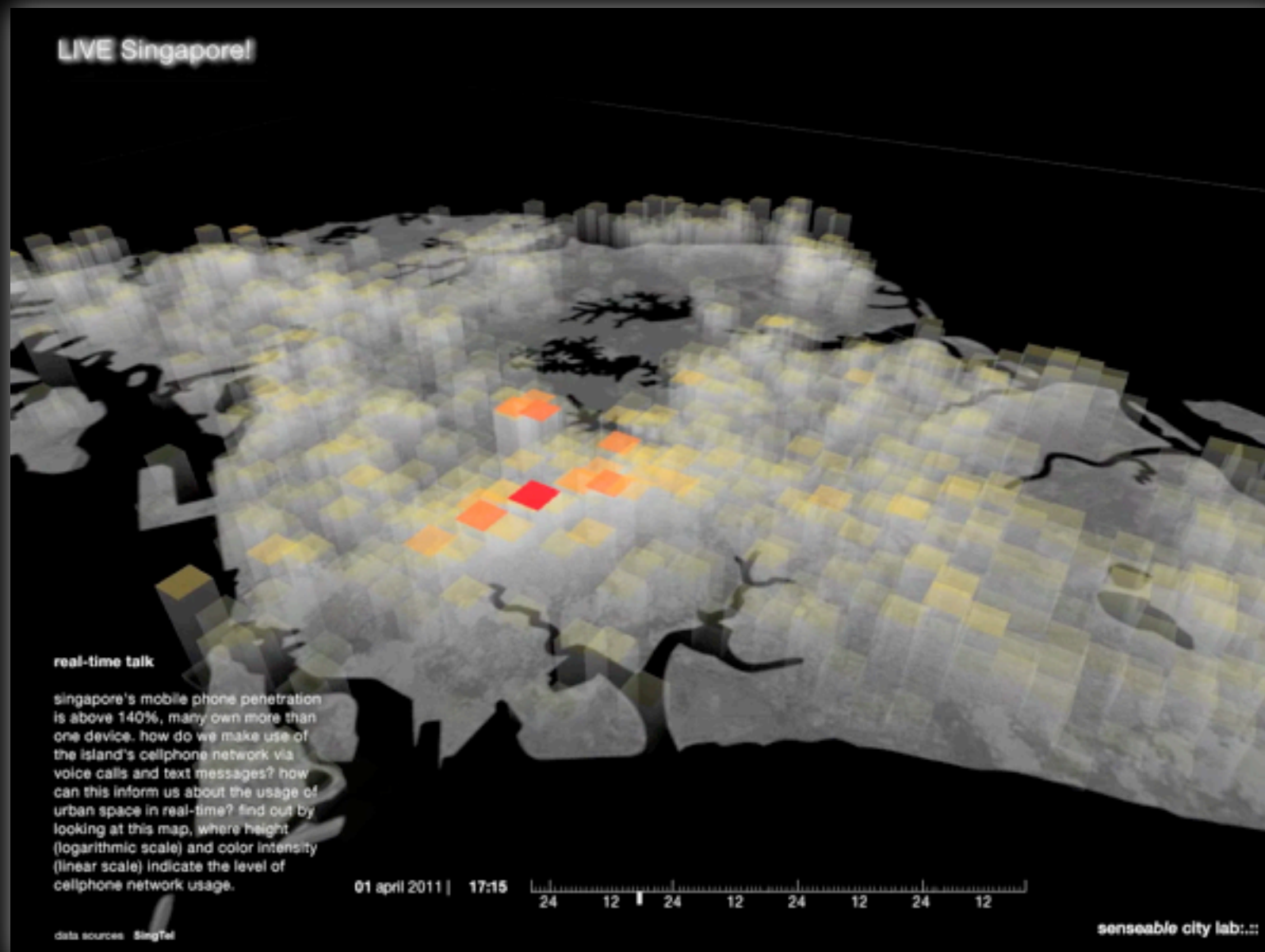


# LIVE Singapore! exhibition

## SAM | Singapore Art Museum | April 2011



# real time talk

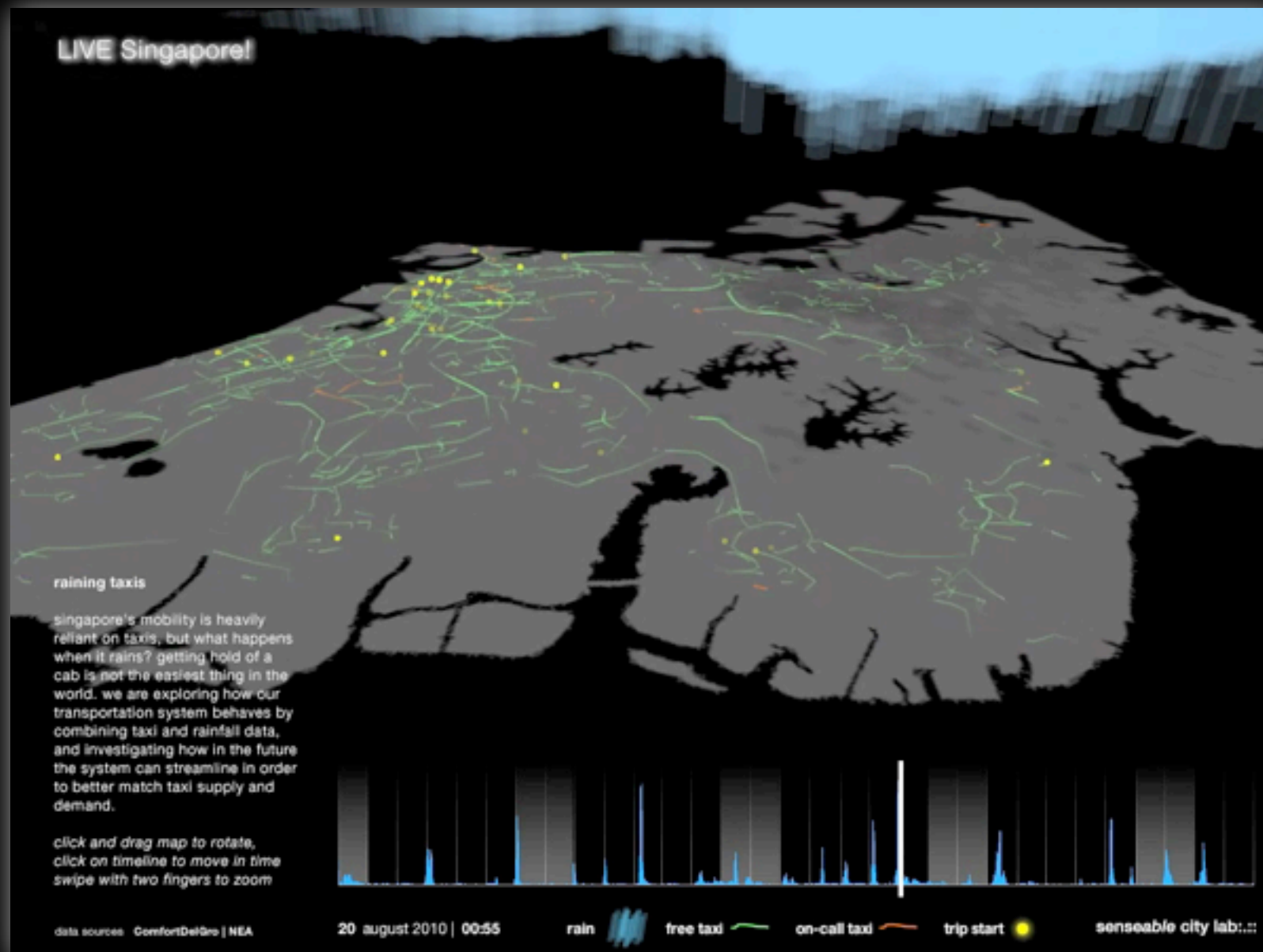




# formula one city



# raining taxis

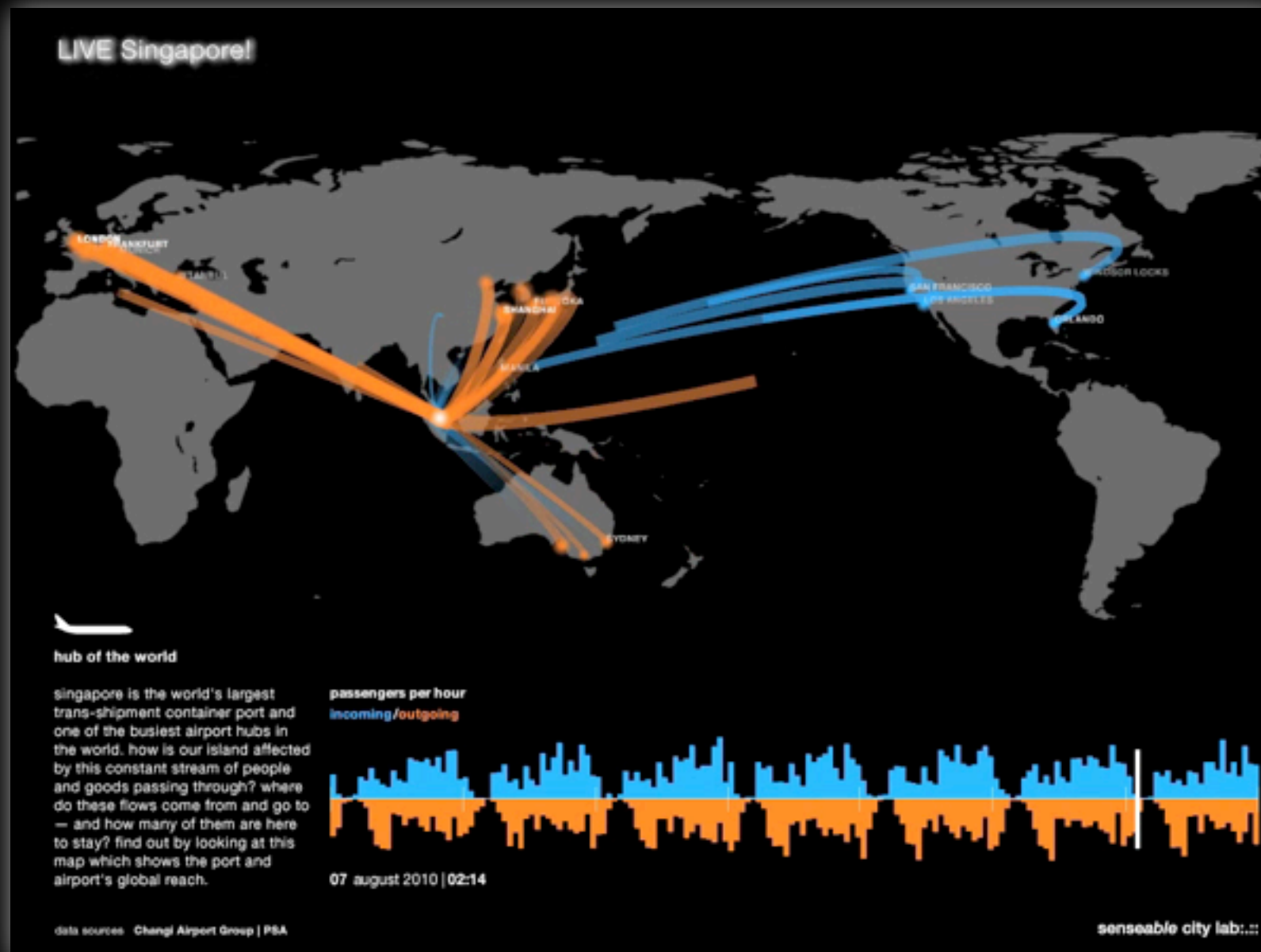




# isochronic singapore



# hub of the world



# **tools and (other) challenges**

## Tools

- Individual tool chain for each researcher
  - Only few are CS people
  - Sticking to the same tools
- Tools commonly used:
  - Matlab, R,
  - OpenMP, MPI
  - Boost Graph Library, Gnu Scientific Library, ...
  - C++, Java, Python, awk, sed, ....
  - Oracle, mySQL, PostgreSQL
- ‘Reproducible Research’ is crucial (org-babel)



## Besides technical challenges

*Understanding (part of) every company/authority you're getting data from.\**

- What system is the data from?
- What is included/excluded in the data set?
- Understanding the data set
- Inconsistencies

\* IT is not their business

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