PETRA Project

1st MOVESMART workshop, Bilbao

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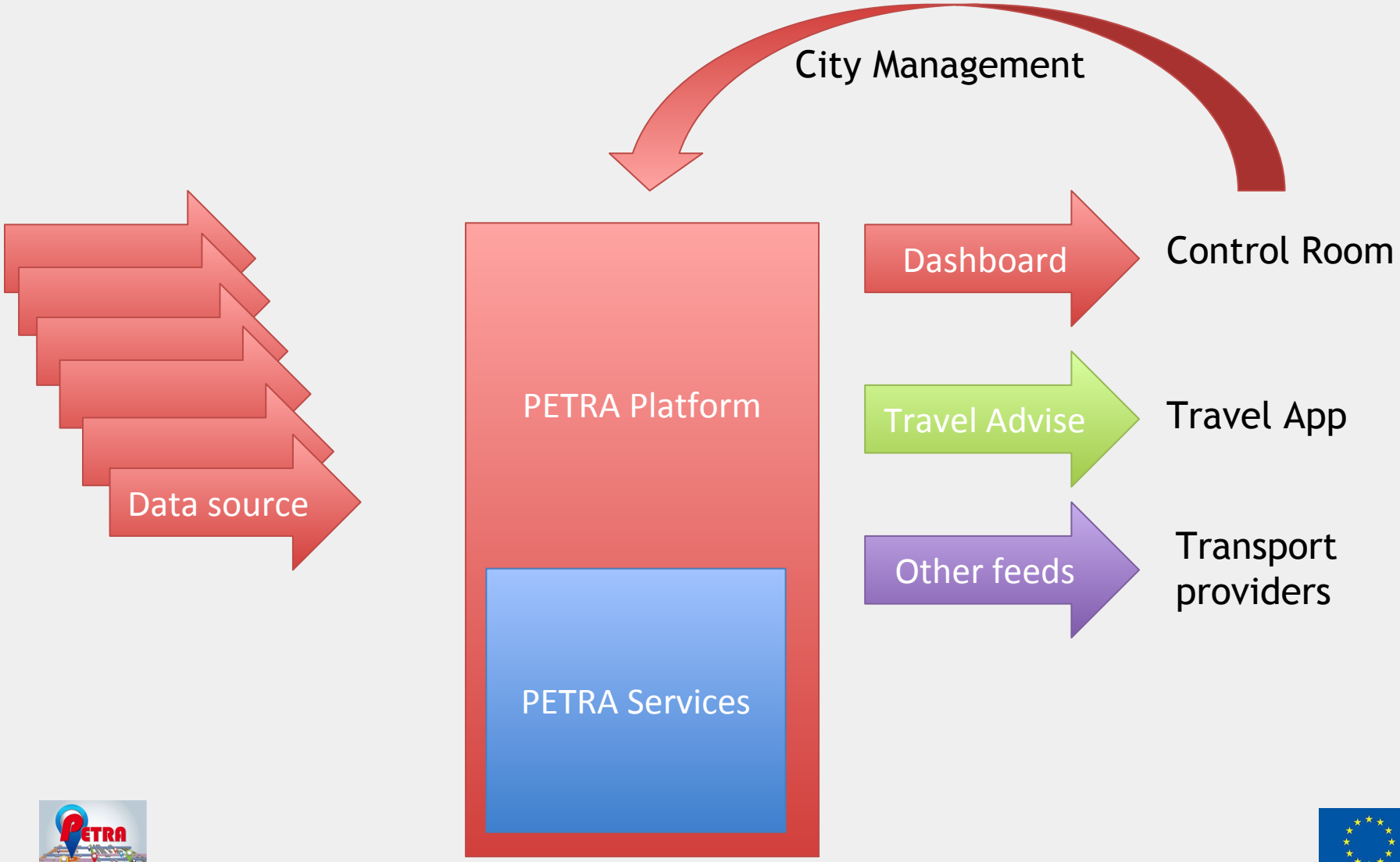
Overview of the presentation

- Partners in PETRA
- Aim and scope of PETRA
- 2 types of users
- A city-owned platform
- Scientific Challenges
  - Technical aspects
  - Data aspects
  - Deployment aspects
- Small Examples

Partners in PETRA

- KTH – Coordinator, simulation, gaming
- IBM – Platform, travel advisor
- RSM – Rome demonstrator
- AVM – Venice demonstrator
- TUD – Governance
- CNR – Data mining
- Technion- Haifa demonstrator

Functional drawing



Aim and Scope

- To develop a **service platform** that connects the **providers and controllers** of transport in cities with the **travellers** (…).
- **Cities** will get an **integrated platform** to enable the provision of citizen-centric, demand-adaptive city-wide transportation services.
- **Travellers** will get mobile applications that facilitate them in making travel priorities and choices for route and modality. (….) involve transportation services and policies to be **adaptive** to the travel demand of the citizens.

Aim and Scope

- The platform will **fuse different data** from various city sources, travel operators and citizens, perform a broad class of **predictive analytics**, detect the **real-time events** (….), and provide **information services** to the transportation service providers and city stakeholders **to optimize** the transportation offerings according to the citizens' interests.
- Attention to the **governance aspects** on how to handle the public – private and privacy issues of such a platform.
- **Three cities** with very different use cases will implement and evaluate the platform and will host **three demonstrations** of a mobile Personal Mobility Advisor app.

2 types of users

- Travellers
  - The ‘usual’ trip planning problem, but now with:
    - Uncertainty on multiple dimensions
    - More robust contingent plan
    - Integrated private transport and soft modes
    - Continuous re-planning under uncertainty

Better average travel time

- Cities
  - New model involving cities in the decisions taken by users allowing for ‘system-wide optimisation’
    - This needs a centralized Data Management platform.
    - Governance

A city-owned platform

- The modern city has many data sources
- Privacy needs to be maintained → processing
- Enriched data, not just raw data → processing
- Own control over own data: agency

- City to provide a service to new service providers.

A city-owned platform

- City to try and optimise the urban dynamics through data
- Governance questions: how are decisions made:
  - Public – Private balance
  - Public goals and operational links
  - Responsibilities and Service model
  - Incentive structures

Scientific challenges

- Research model:
  - Close to real-world problem
  - Identify hard problem and provide new methods
  - Balance between demonstrations and papers

- Technical challenges
- Data challenges
- Deployment challenges

Technical challenges

- From the technical research perspective, challenges come from the following novelties:
  - City awareness: Getting a **real-time predictive model** of the city with a limited amount of data
  - Mobility pattern mining: Inferring **semantics** from both individual and aggregated mobility data.
- From the technical research perspective, challenges come from the following novelties:
  - Uncertainty-aware planning: Exploiting real-time predictive model for more **robust, shorter trips**
  - Simulation: Predicting **sensible robust future states** without high-dimensional source data.

On routines…..

- There are many movements in cities
  - Under-exploited: private cars, car-sharing, soft modes, etc.
- Vision: identify ‘routines’ from individual (phone) data and distinguish them into likely available modes of transport
- This will facilitate ‘mobility as a service’ in any future concept.

Data challenges

- PETRA uses an unprecedented combination of data for giving advises:
  - static GTFS
  - real-time transit network data
  - individual and collective mobility patterns
  - Information on city attractions and events
- Real-world data presents challenges that require smart and sometimes radically new methods
  - Example Rome: real-time data mismatch with bus service.
  - Most real-world sources have not been built for mobility advice: need additional algorithms.

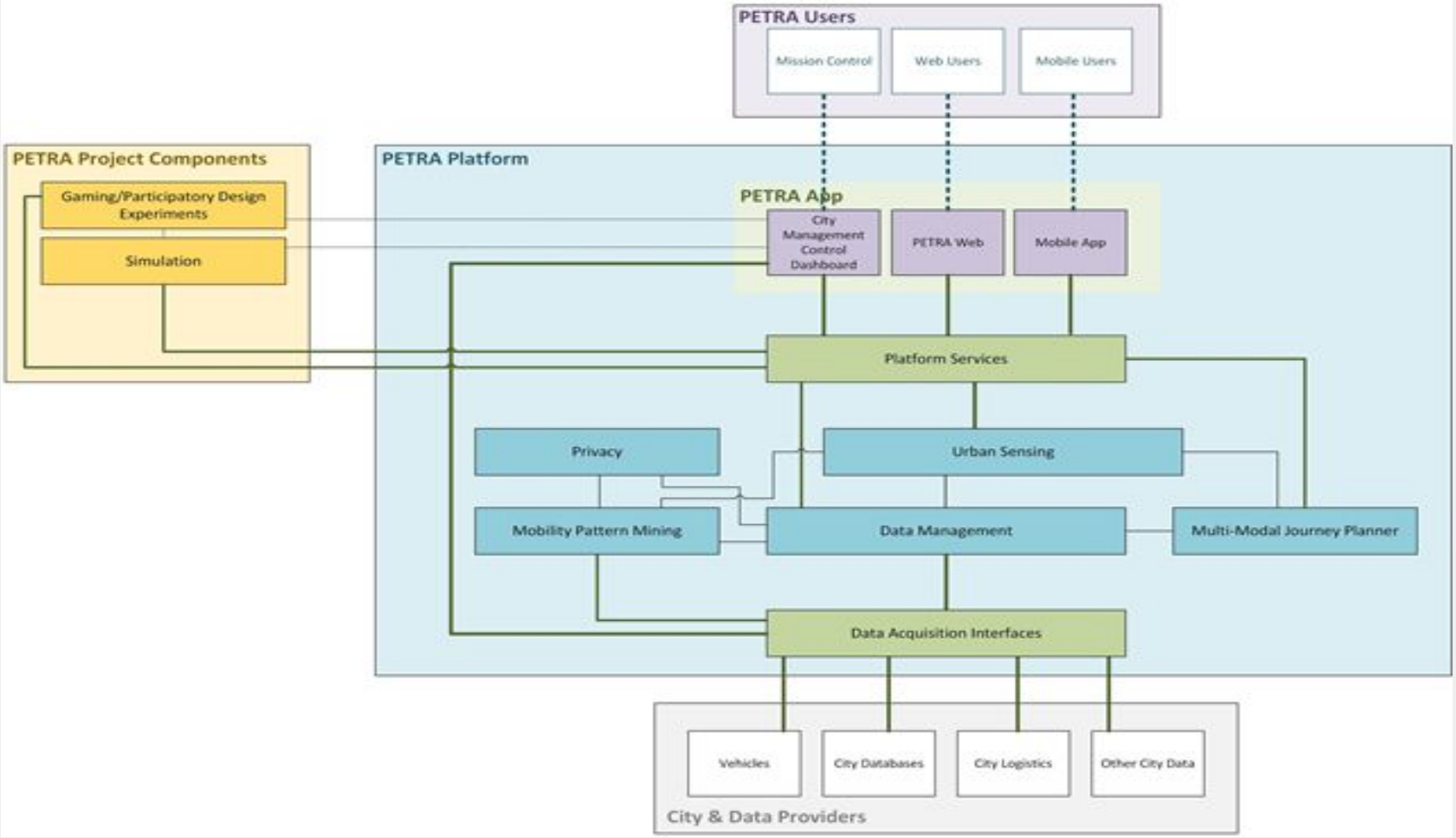
Deployment challenges

- Scalability, and platform independence as design goals: CloudFoundry solution (1st mobility advise platform!)
  - Example Rome: existing infrastructure cripples under PETRA load.
- Cities responsible for data subscription:
  - Different owners, even within cities
  - Different formats
  - Different semantics
  - Requires smart data management platform as a service

Deployment challenges

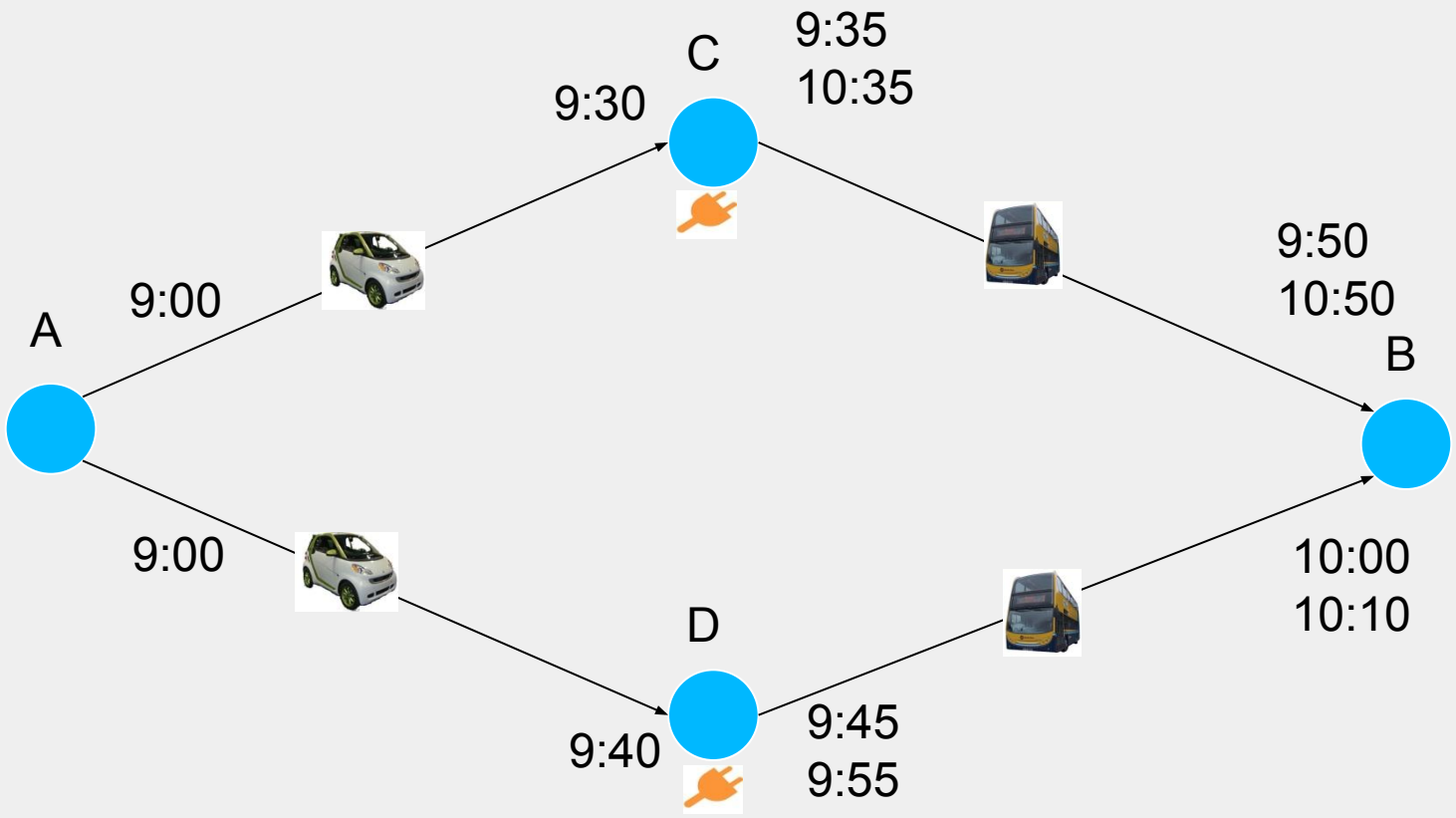
- Governance aspects:
  - Who owns the platform, who guarantees the service, who takes the risk?
  - What does the city get in return for providing the service?
- Gaming:
  - As a method to design the actual interfaces / dashboards
  - As a method to formulate Real Options in control strategies
  - Closing the gap between policy and operations

Summary

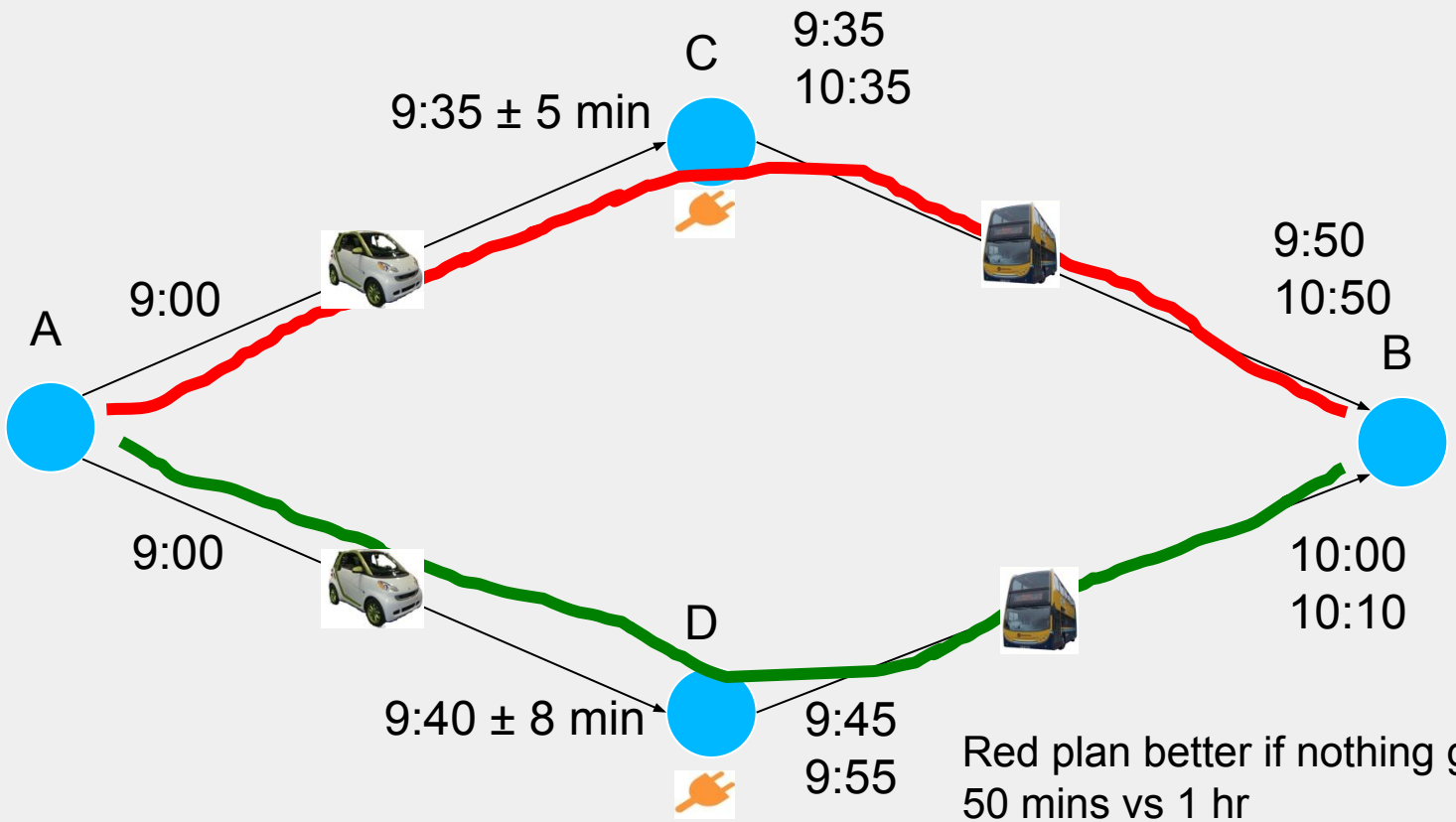

PETRA Users
Mission Control
Web Users
Mobile Users
PETRA Project Components
Gaming/Participatory Design Experiments
Simulation
PETRA Platform
PETRA App
City Management Control Dashboard
PETRA Web
Mobile App
Platform Services
Privacy
Urban Sensing
Mobility Pattern Mining
Data Management
Multi-Modal Journey Planner
Data Acquisition Interfaces
Vehicles
City Databases
City Logistics
Other City Data
City & Data Providers

Example

Use case: drive-park-ride in the presence of uncertainty



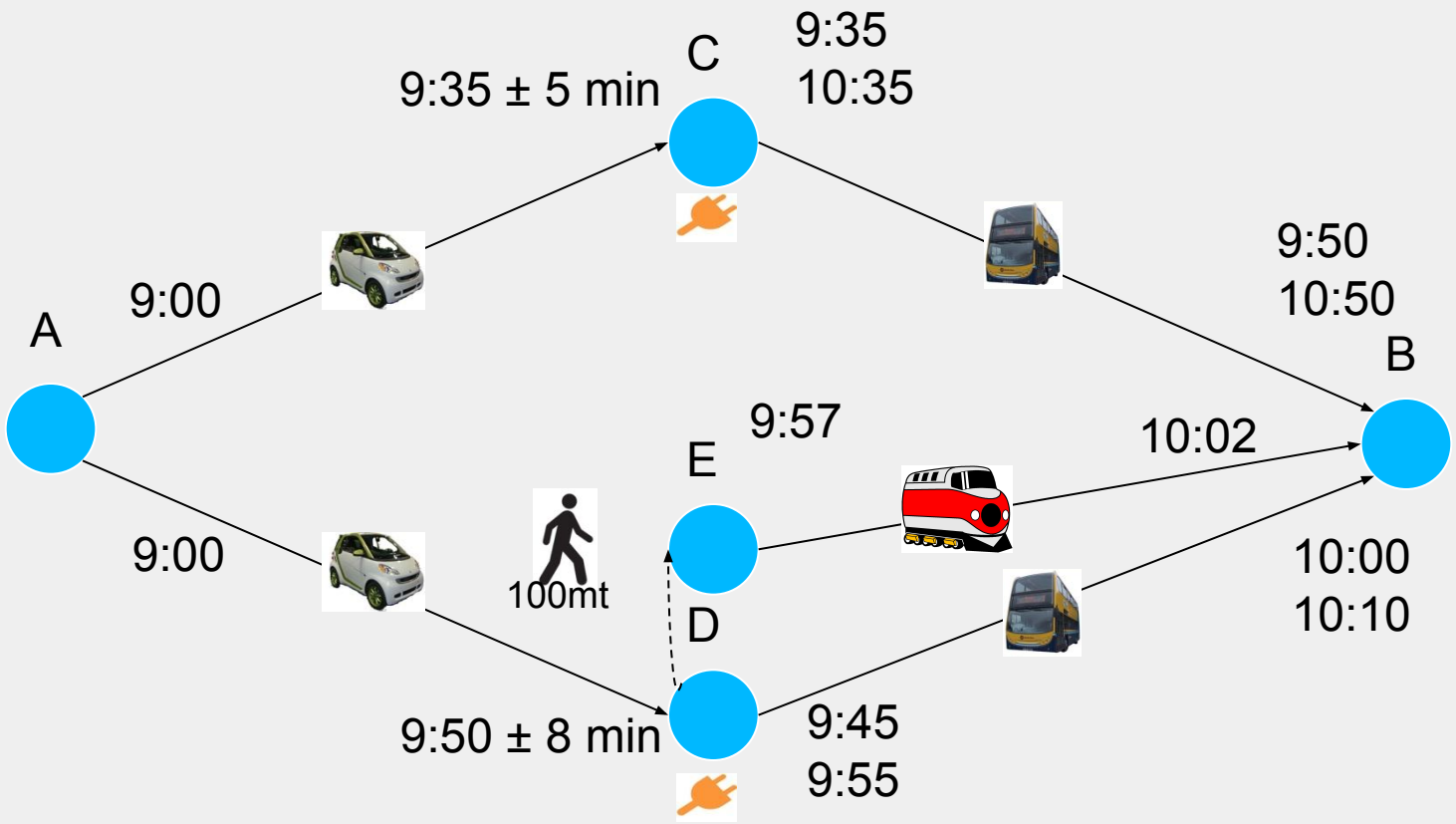
Use case: drive-park-ride in the presence of uncertainty



Red plan better if nothing goes wrong
50 mins vs 1 hr
But there is uncertainty about:

- Driving time, and/or
- Duration of waiting for a charging pole

Use case: drive-park-ride in the presence of uncertainty



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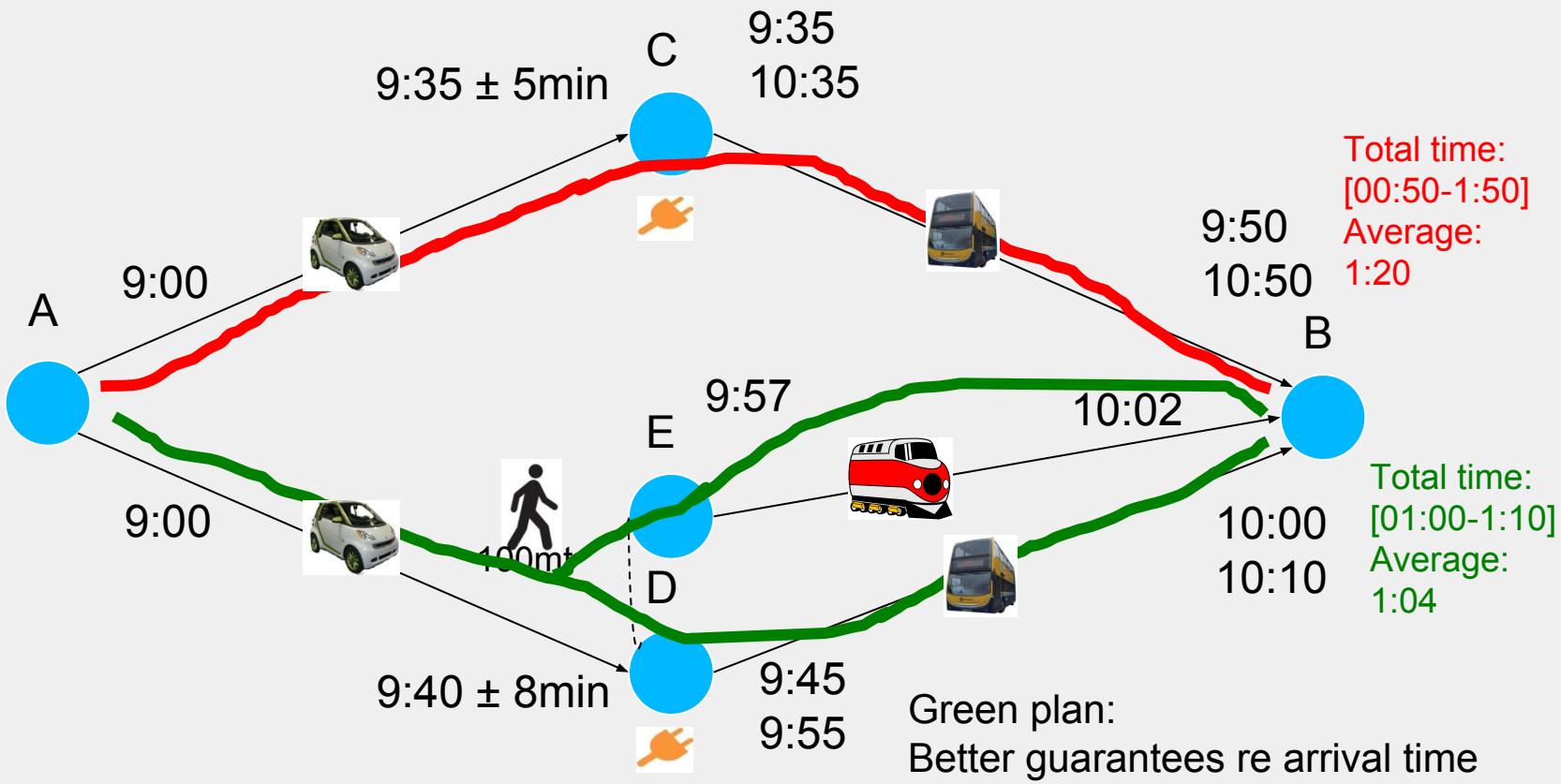
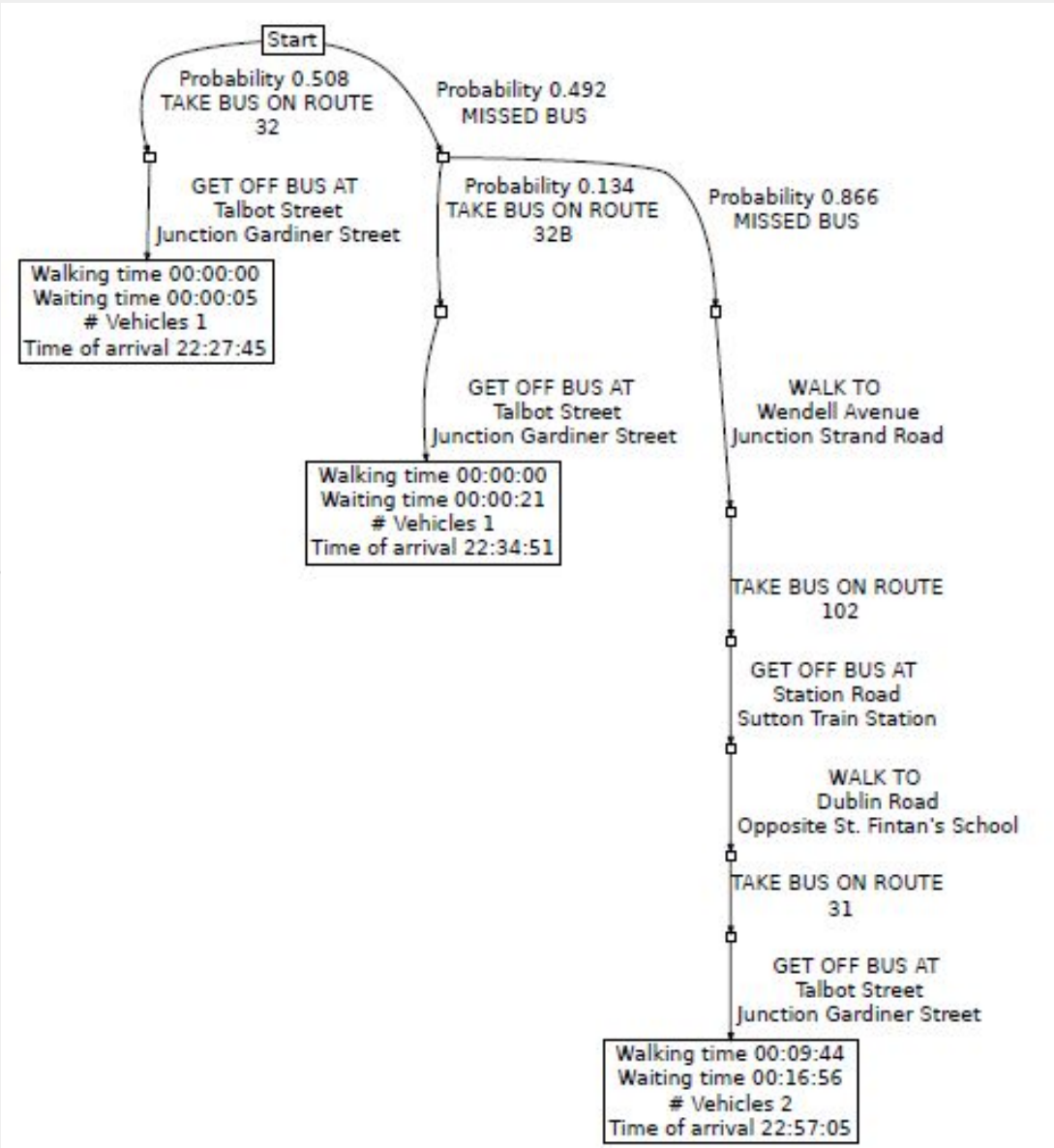


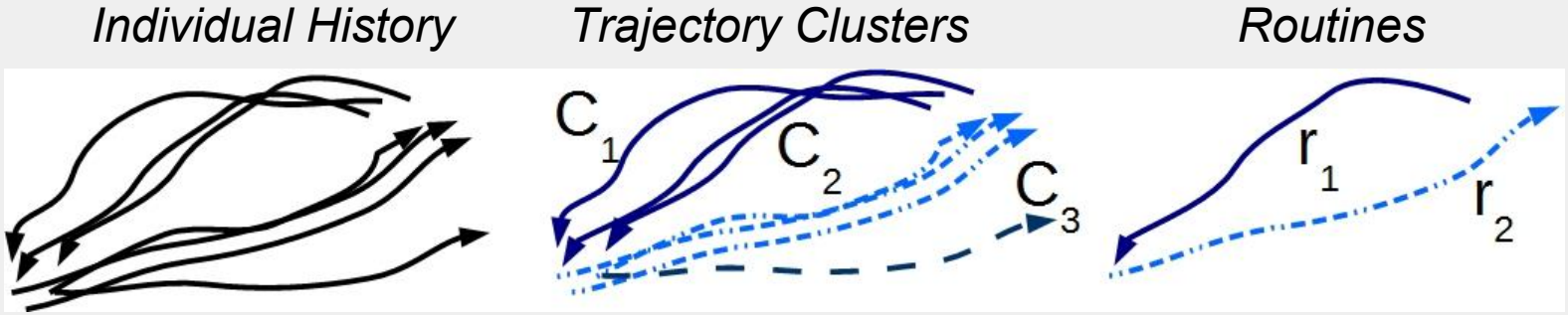
Journey plan computation

- Global optimisation across modes
- Travel time and money cost guarantees
  - Take uncertainty into account
  - Prefer plans not prone to failure
  - Have back-up options precomputed (example)
  - Scalable replanning when all else fails



Mobility Profiles

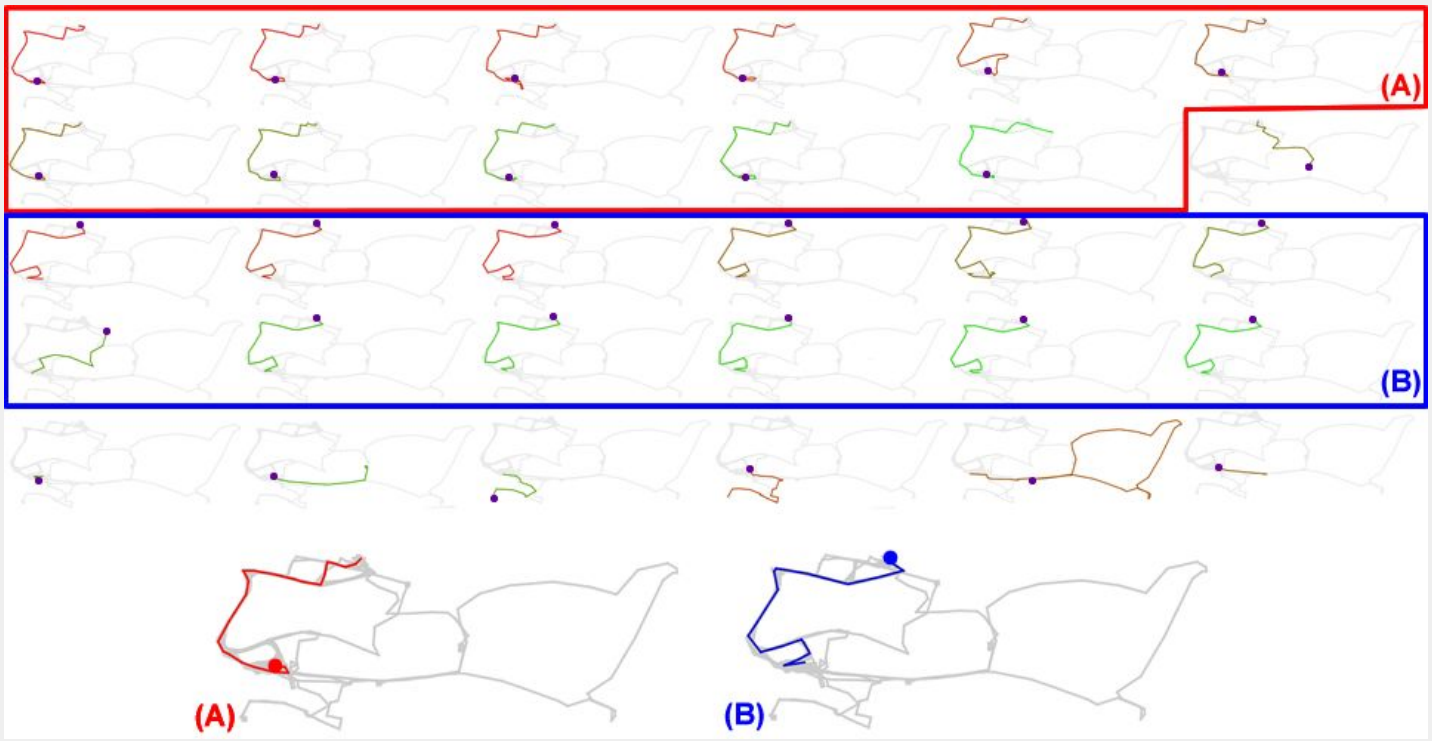
- Describe an abstraction in space and time of the **systematic movements** of a user.
- A user mobility profile contains all his **routines**, each characterized **spatially** (origin, destination and path followed) and **temporally** (e. g. hour of the day of start and end)
- Based on trajectory clustering with noise removal



- Routines = trips that most likely will take place also in the future

→ Applications in **prediction** and **carpooling**

Sample mobility profiles



User with two routines (home-work?) forming his mobility profile, which covers ~80% of his mobility

Thank you for your attention.