

10th Workshop on Principles and Practice of Consistency for Distributed Data

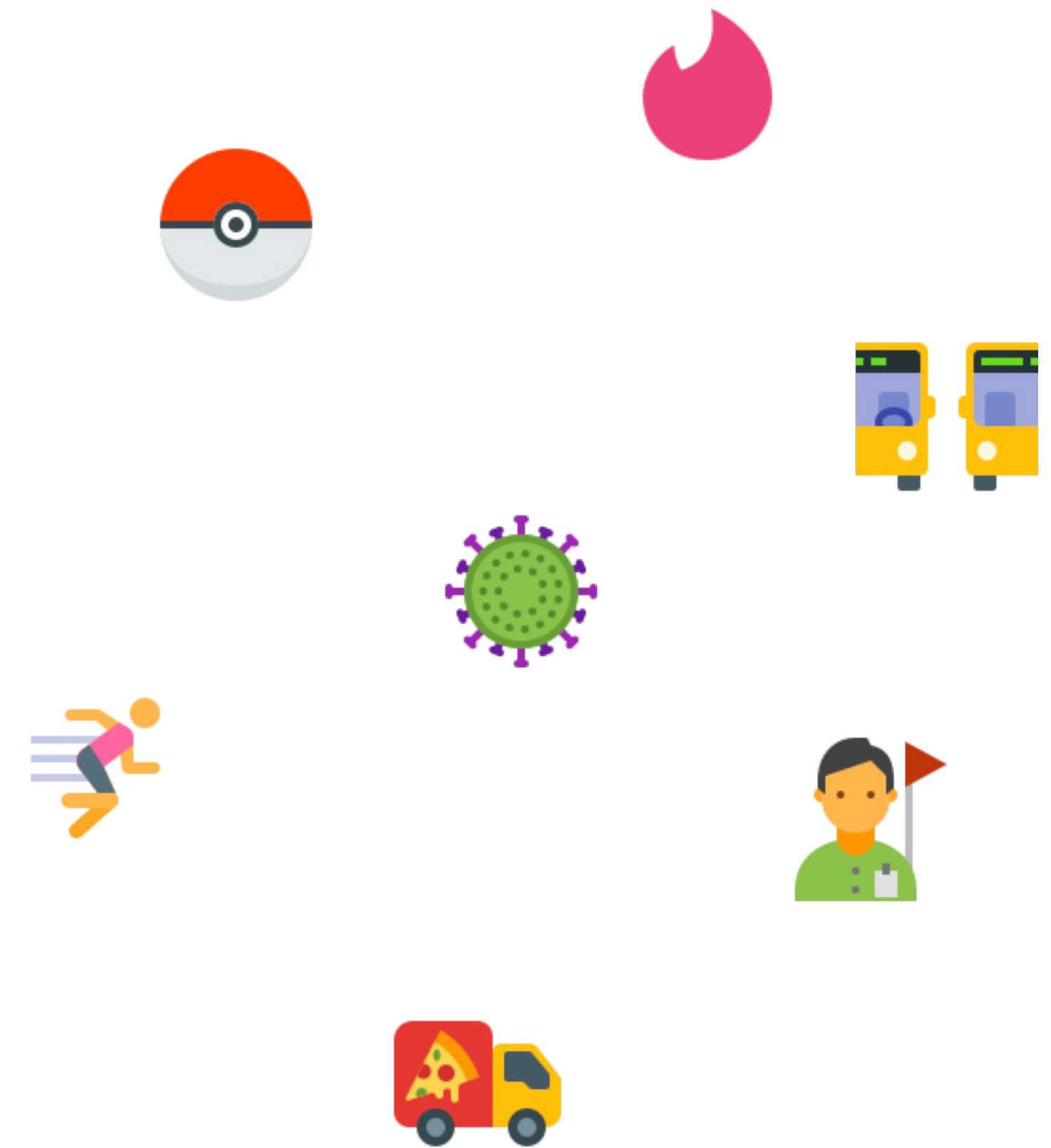
Data Management for mobile applications dependent on geo-located data

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Motivation

- Mobile devices have become the preferred platform for deploying new applications.
- Some applications need to share and manipulate location-dependent data.
- Examples of those applications are vehicular applications or mobile multiplayer games.



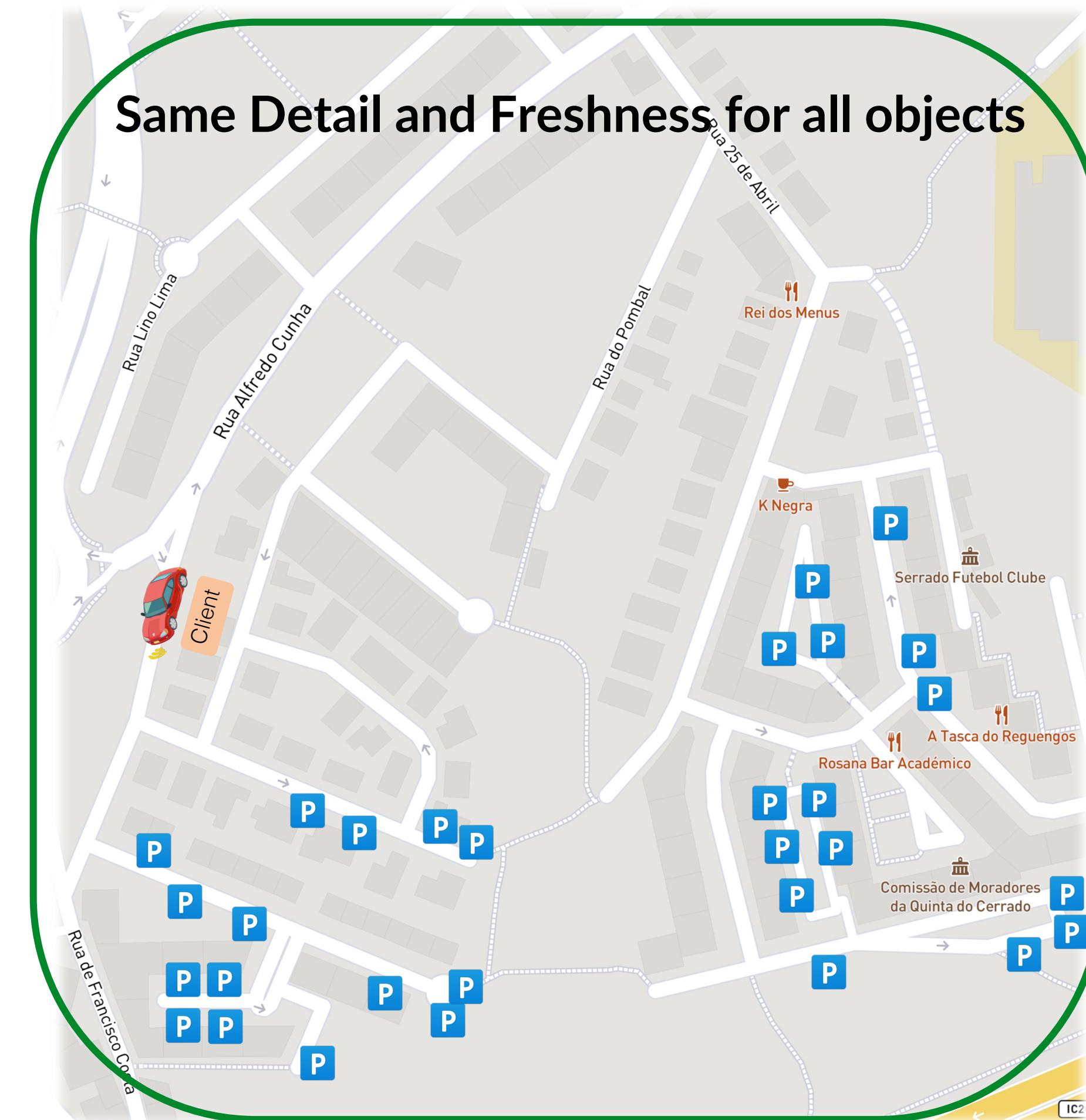
Motivation

- The user's interest in data directly correlates to its distance to that data.
- Storage maintains a single data model, and consistency is uniform for all data.



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Desired properties

- Proximity-based Interest and Explicit User Preferences
- The system is not aware of the user's intentions.
- We need a mechanism that informs the system of the user's interest.



Desired properties

- Adaptive Data Detail Exposure
- Systems maintain a single data model
- It is a requisite to provide a flexible non-uniform data model.

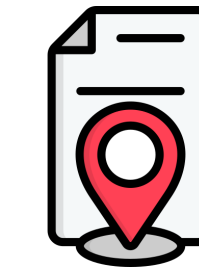


Desired properties

- Dynamic Inconsistency Management
- Systems provide consistency models without fine-grained control
- A system could adjust the frequency of updates to manage the degree of inconsistency.



FocusDB



Objects

- **Cloud Side** responsible for allowing data access and manipulation methods



Database

Focus DB API

View Manager

Notification Sys

- **Client Side** interacts with the cloud using a library





Clients



Focus DB Client lib

Data Model



Spots	Streets View	Neighborhood View
(Street1, ) (Street1, ) (Street1, ) (Street2, )	(Street 1, 3) (Street 2, 1)	(Business District, 4)



(Street_1, 3)
(Street_2, 1)



Business District

Street 1

Street 2



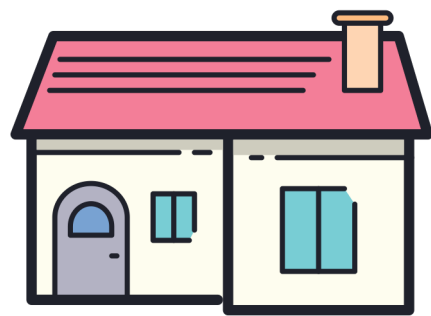
Example



Spots	Streets View	Neighborhood View
(Street1, ) (Street1, ) (Street1, ) (Street2, )	(Street 1, 3) (Street 2, 1)	(Business District, 4)



Business District



Home



Client

Street 1

Street 2



Example



Spots	Streets View	Neighborhood View
(Street1, ) (Street1, ) (Street1, ) (Street2, )	(Street 1, 3) (Street 2, 1)	(Business District, 4)



Destination



Business District

Street 1 Street 2



Home




Client

Spots	Streets View	Neighborhood View

Example



Spots	Streets View	Neighborhood View
(Street1, ) (Street1, ) (Street1, ) (Street2, )	(Street 1, 3) (Street 2, 1)	(Business District, 4)



Destination



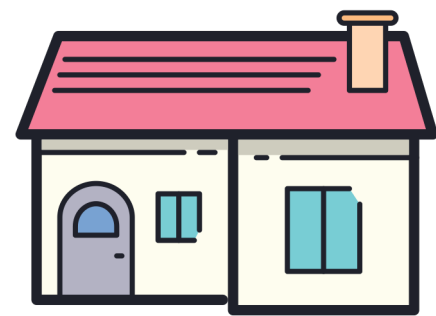
Business District



(Business District, 4)

Street 1

Street 2



Home



Client

Spots	Streets View	Neighborhood View

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(Street1, ) (Street1, ) (Street1, ) (Street2, )	(Street 1, 3) (Street 2, 1)	(Business District, 4)



(Street 1, 3)
(Street 2, 1)



Client

Spots	Streets View	Neighborhood View
		(Business District, 4)

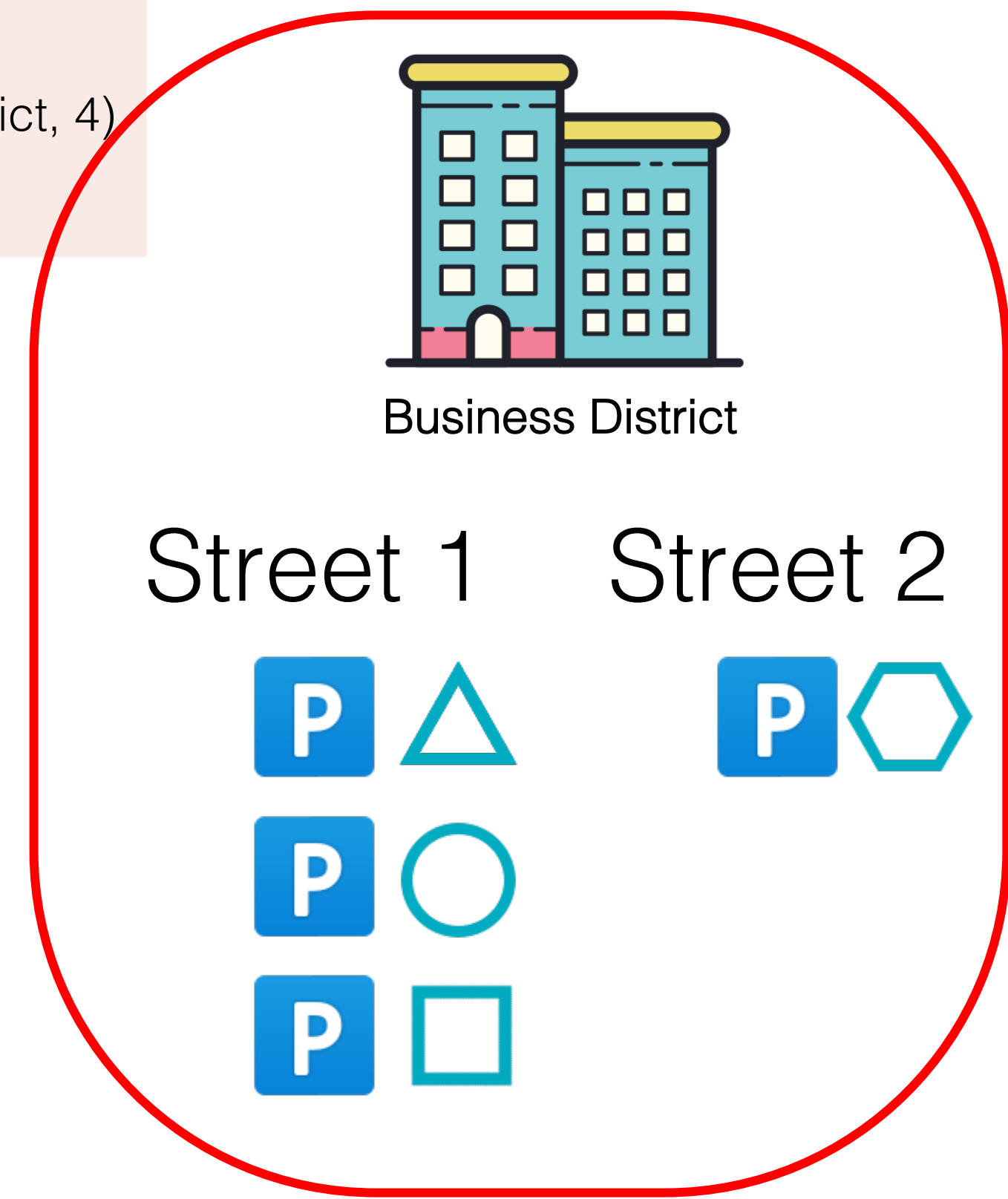


Destination



Business District

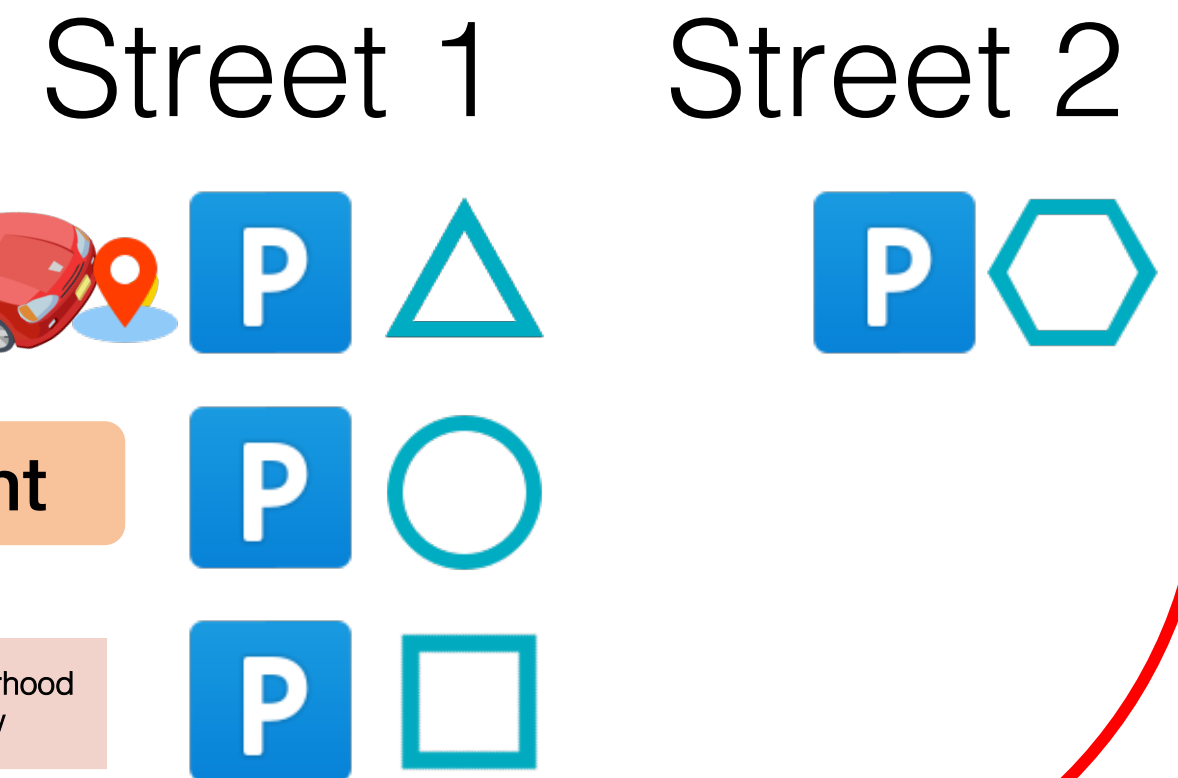
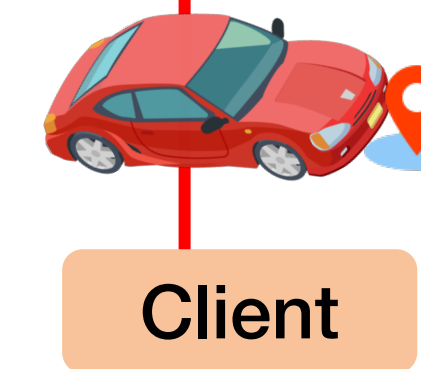
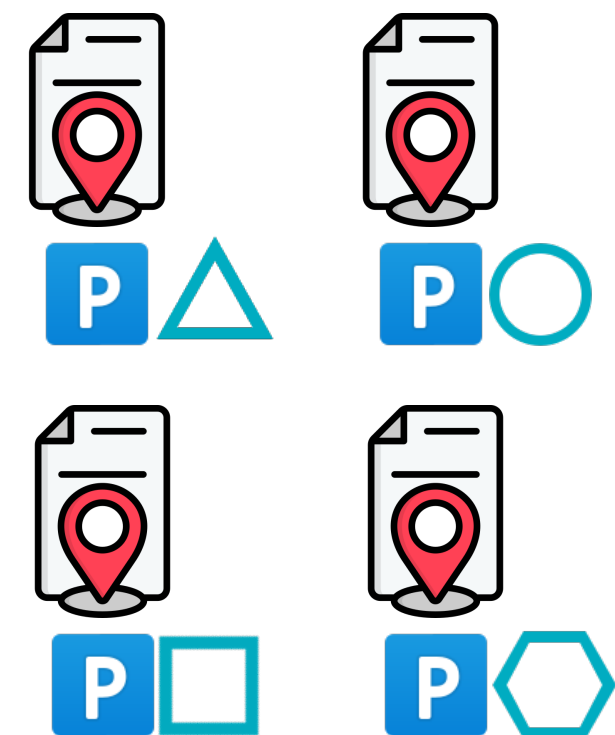
Street 1 Street 2



Example

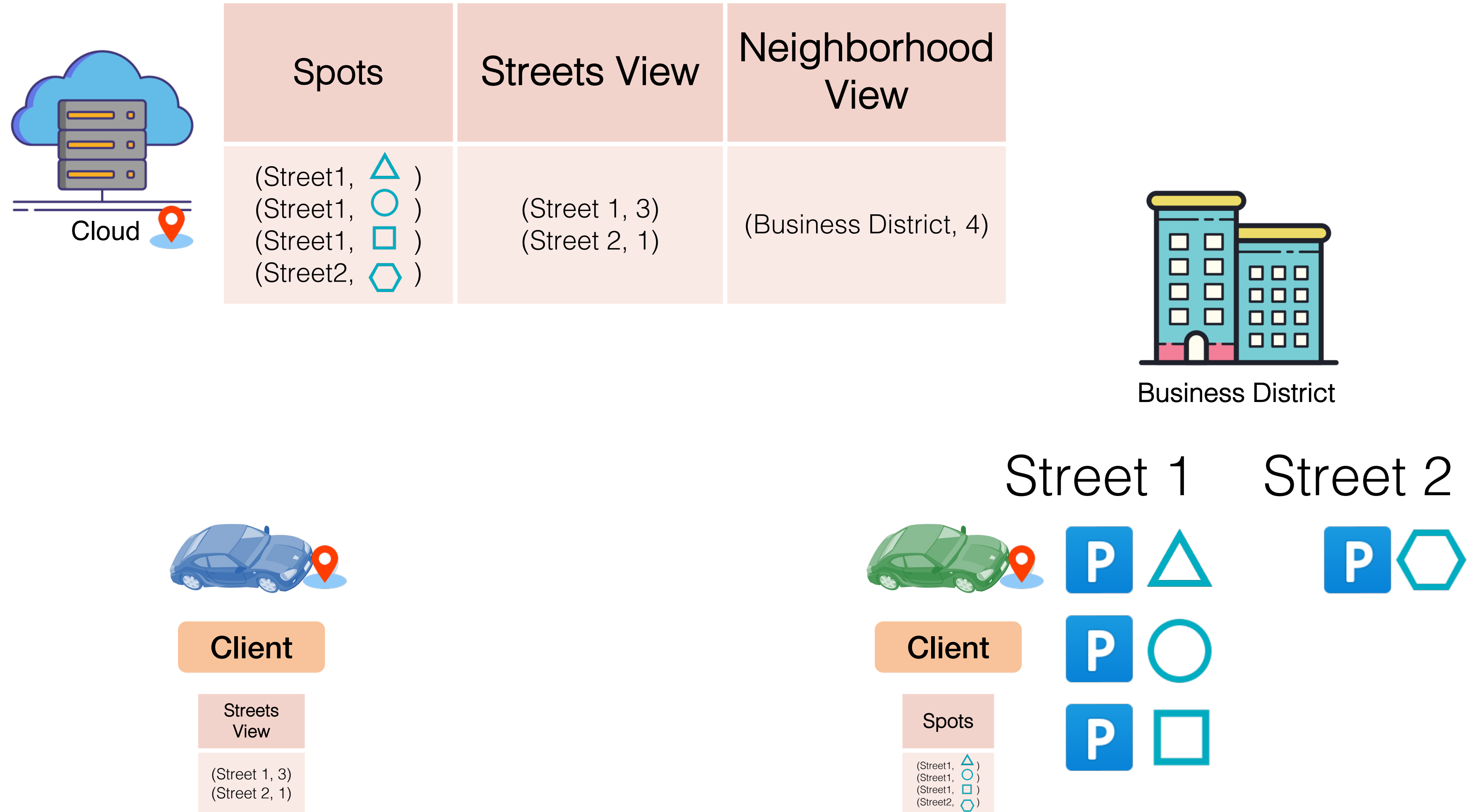


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(Street1, ) (Street1, ) (Street1, ) (Street2, )	(Street 1, 3) (Street 2, 1)	(Business District, 4)

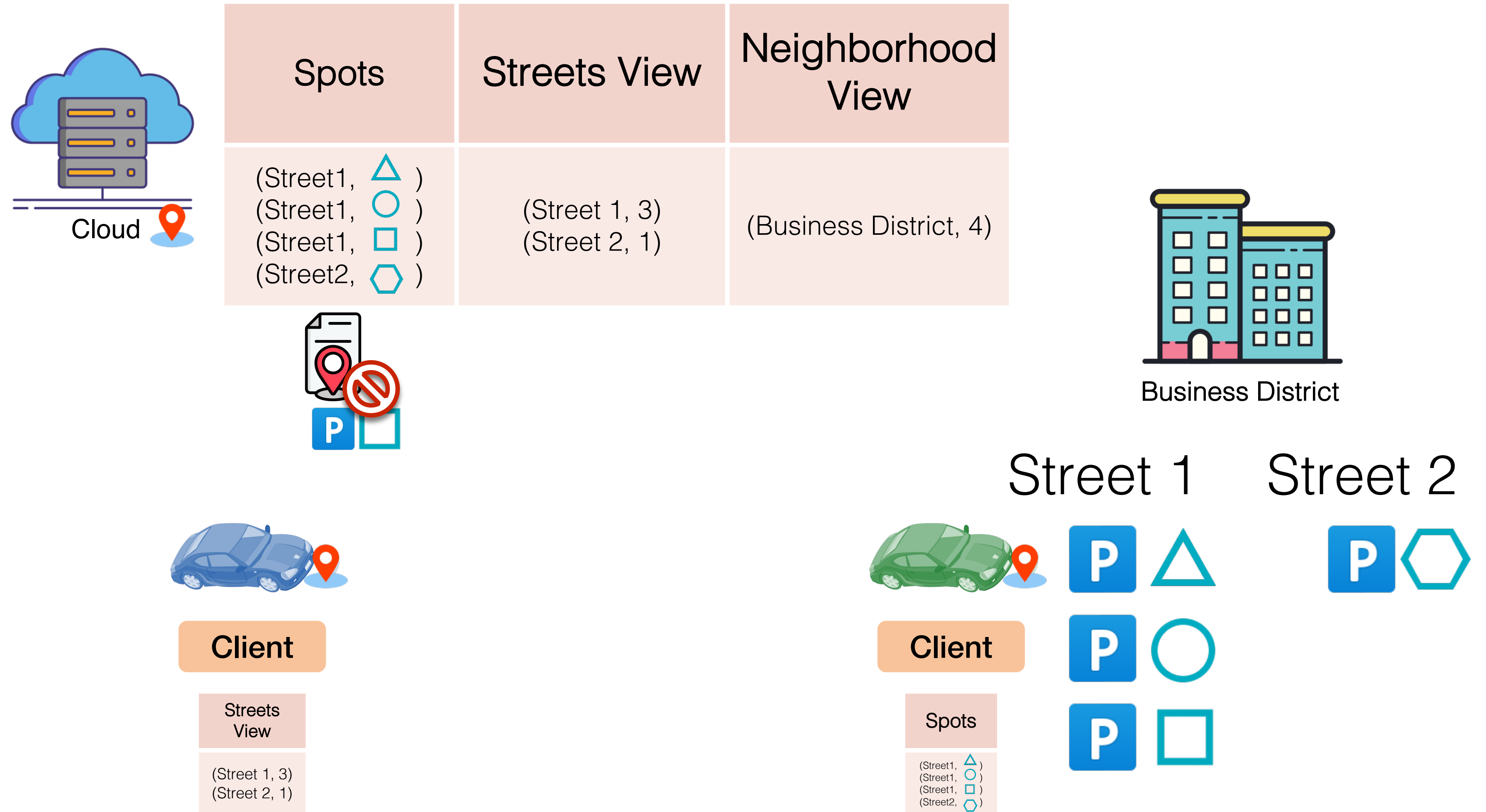


Spots	Streets View	Neighborhood View
	(Street 1, 3) (Street 2, 1)	(Business District, 4)

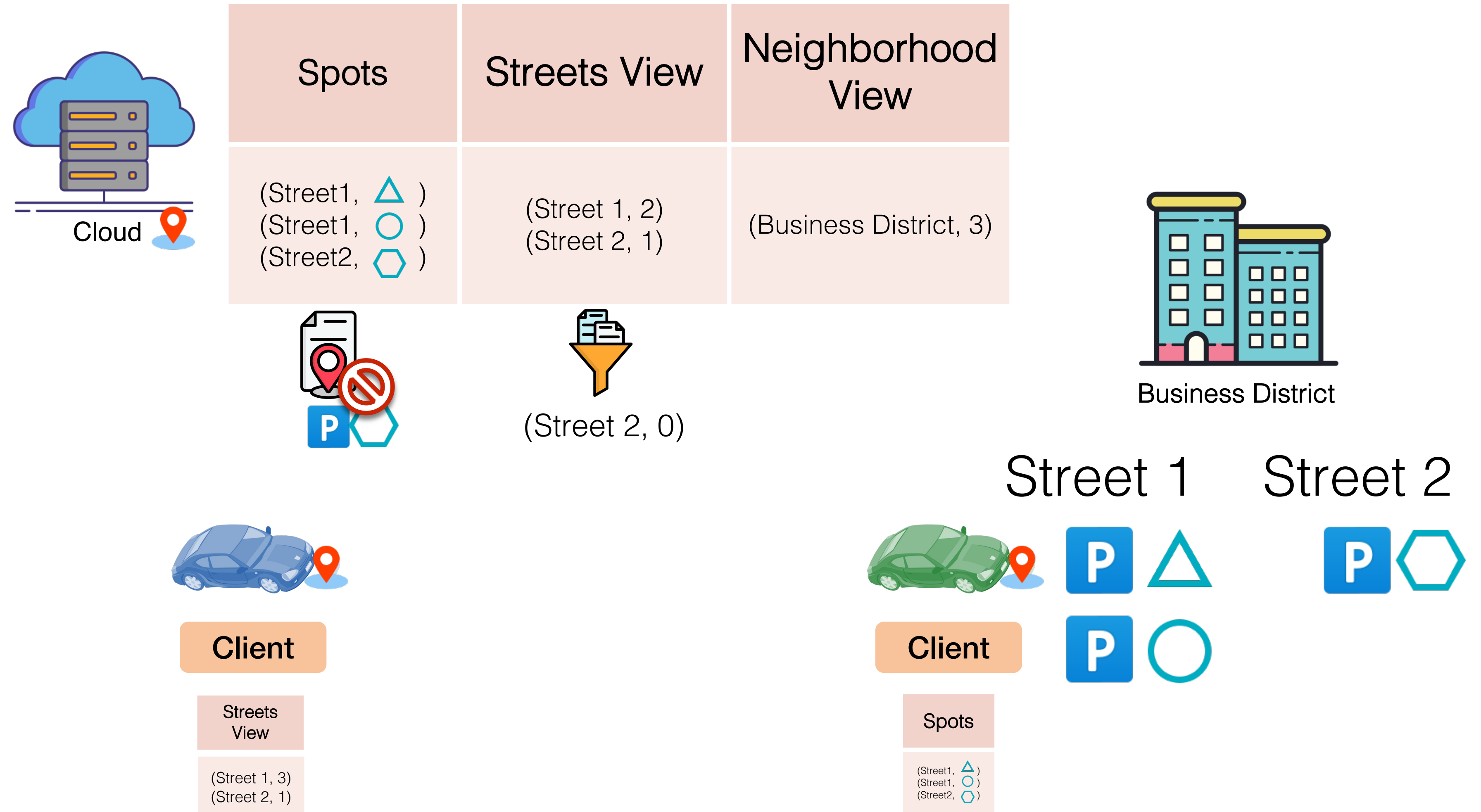
Data Freshness



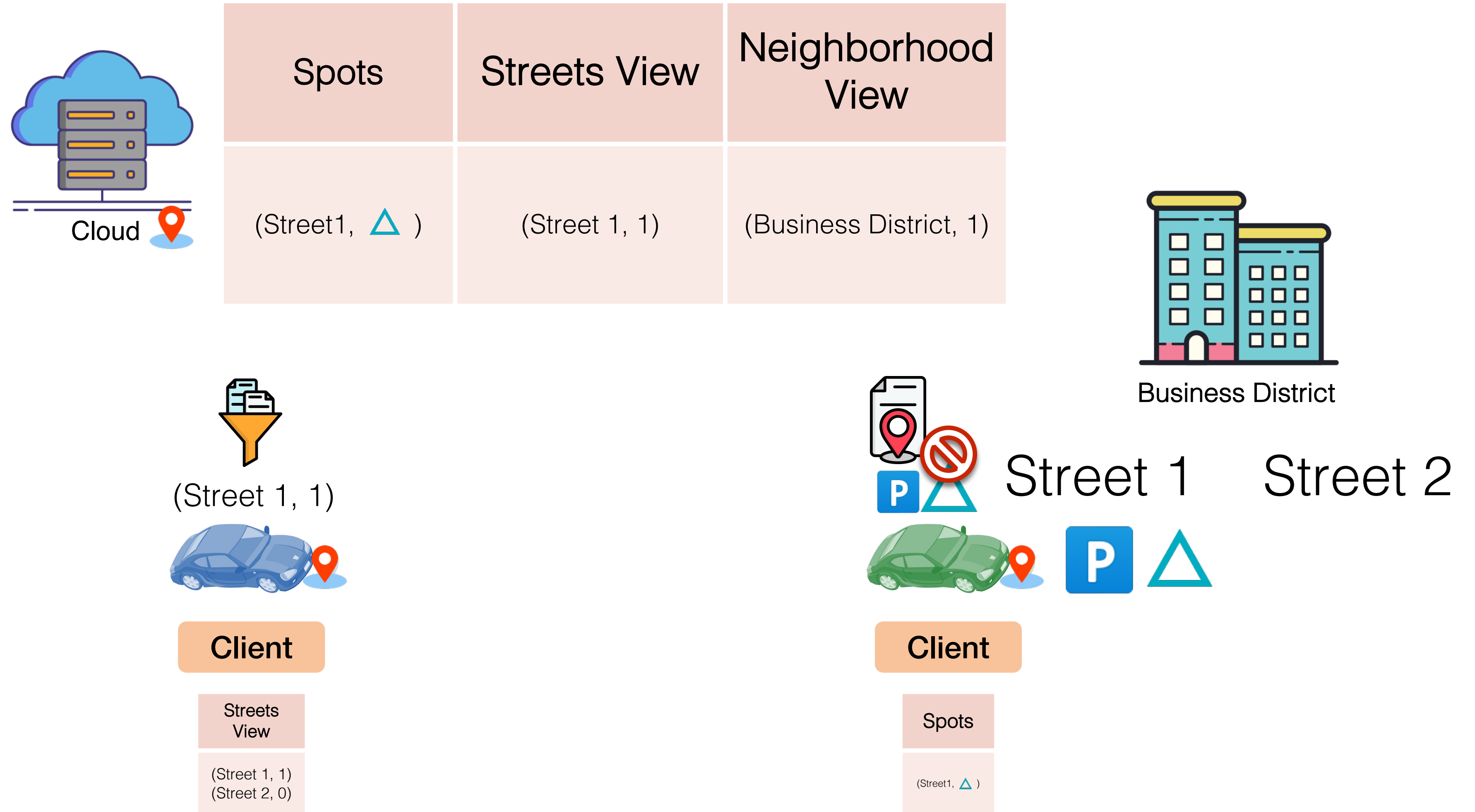
Data Freshness



Data Freshness



Data Freshness





Evaluation

- While this work is still a work in progress, we've already conducted some preliminary experiments and evaluations.
- Does using a flexible non-uniform data model translate into benefits of performance?



Evaluation

- Where to Park? Application
- Built a workload generator that mimics multiple mobile clients
- Prototype of FocusDB, plus two additional architectures
- Evaluated throughput and latency as a function of the number of clients and the total number of client requests



Evaluation

- Two datasets
 - one for client movement
 - the other for object placement (Parking Spots)
- Clients follow a path with Parking Spots in that route.



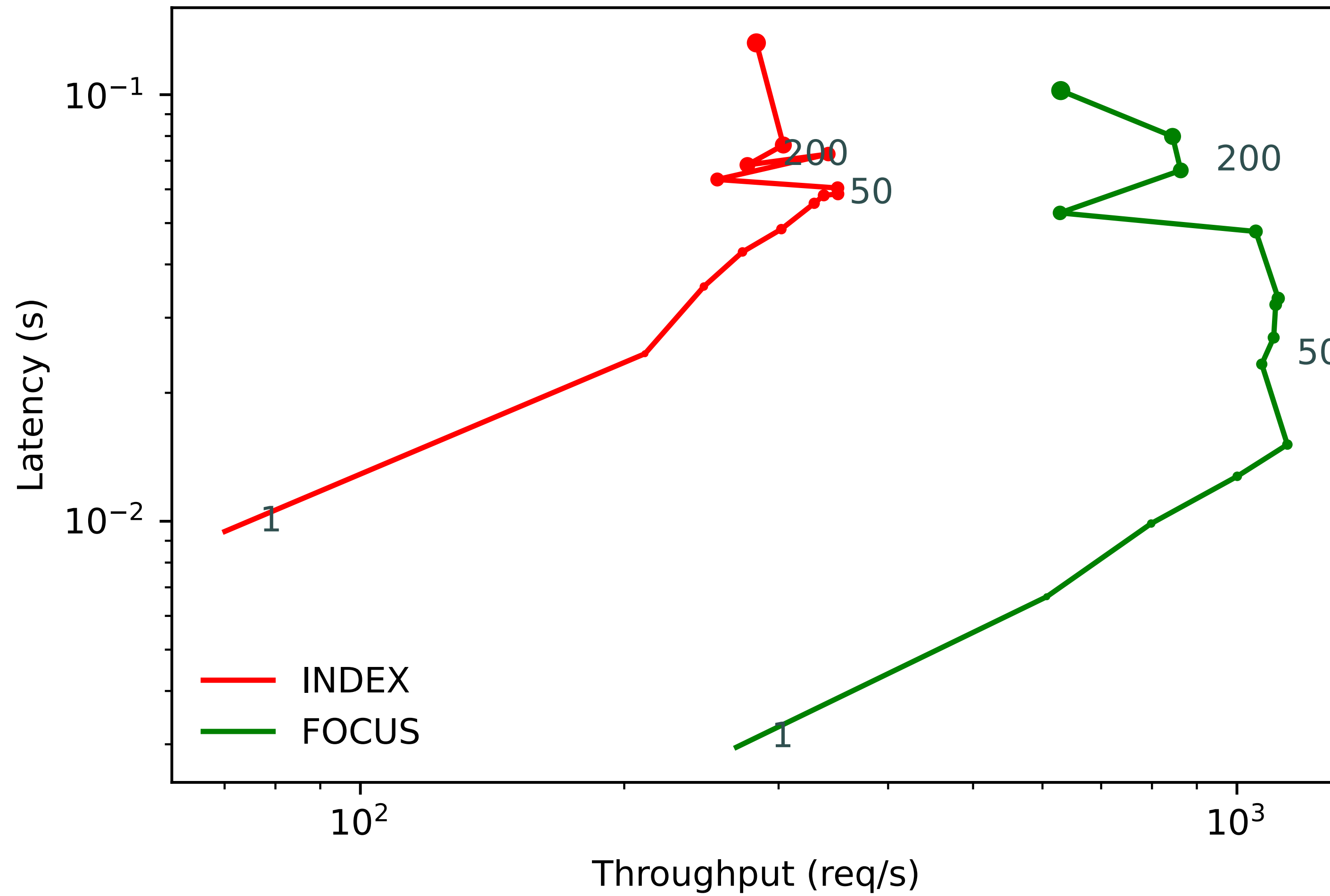
Evaluation

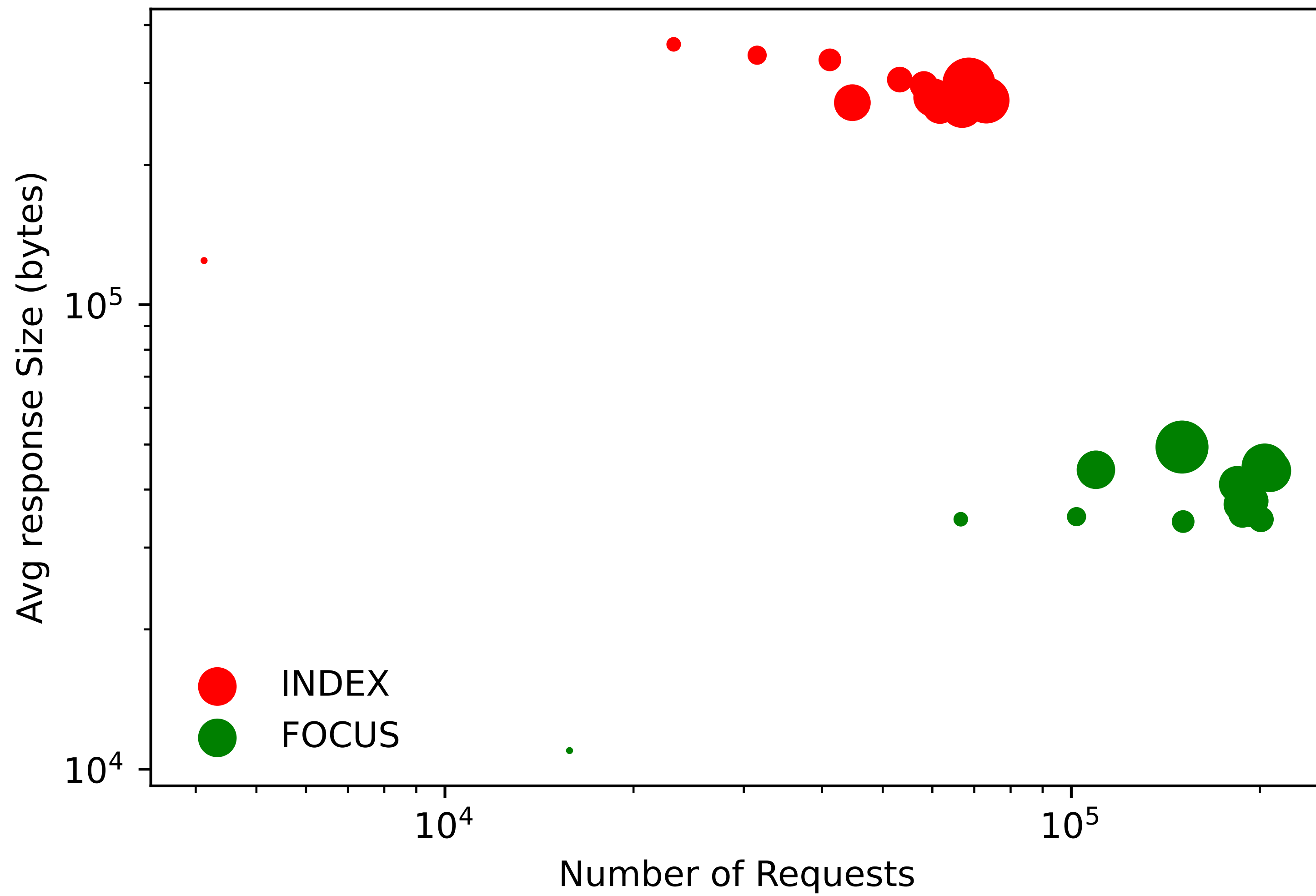
- A client initiates a request by specifying the end location of the trip, which indicates the interest set regarding parking spots
- Client receives 3 levels of detail during the trip
 - Neighbourhood view -> Multiple street view -> Street view
- 5 Trips per Client per Test
- 80% aggregations and 20% full objects



Evaluation

- Two different implementations
 - FocusDB prototype (FOCUS)
 - MongoDB Queries with indexes on relevant attributes (INDEX)







Future Work

- Formalise the consistency model.
- Continue to explore location as a property for implementing efficient replication protocols.
- Expand the system model to a hierarchical cloud – edge.



Summary

- Introduced FocusDB: a system for geo-located data in mobile environments
- Data model that accounts for objects and client locations
- Levels of detail based on client location
- Adaptive consistency guarantees based on client interest
- Drawbacks: increased metadata traffic and cloud storage usage

Thank You!