

TOWARDS BUILDING REAL-TIME, CONVENIENCE ROUTE RECOMMENDATION SYSTEM FOR PUBLIC TRANSIT

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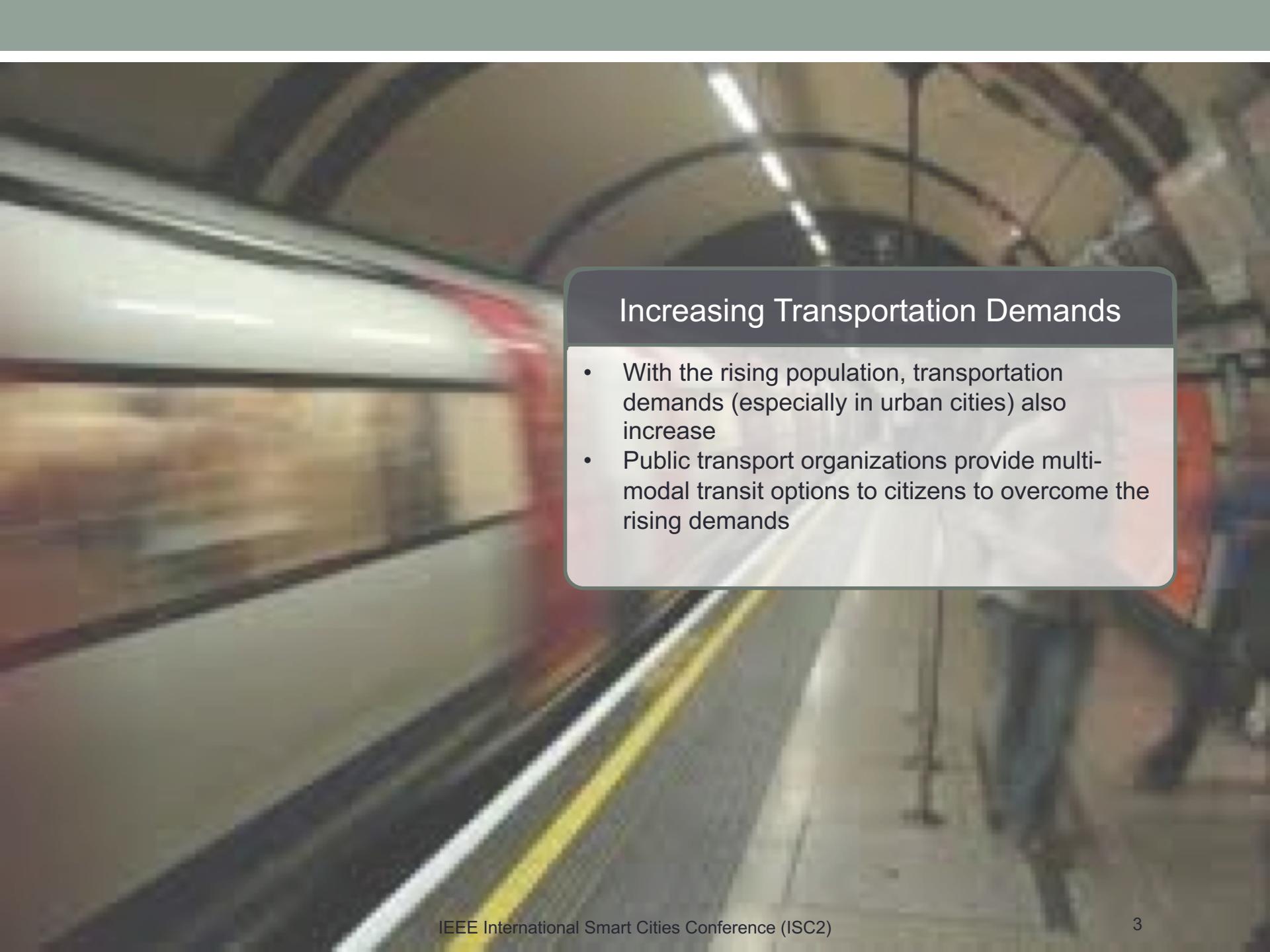
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Outline

- Increasing transportation demands
 - Placing public transportation in picture
- Commuter experience in public transit
 - Need for personalizing public transit services
- Our vision to personalize public-transit solutions
- Proposed system
- System Requirements
- Implementation Details
- Conclusion



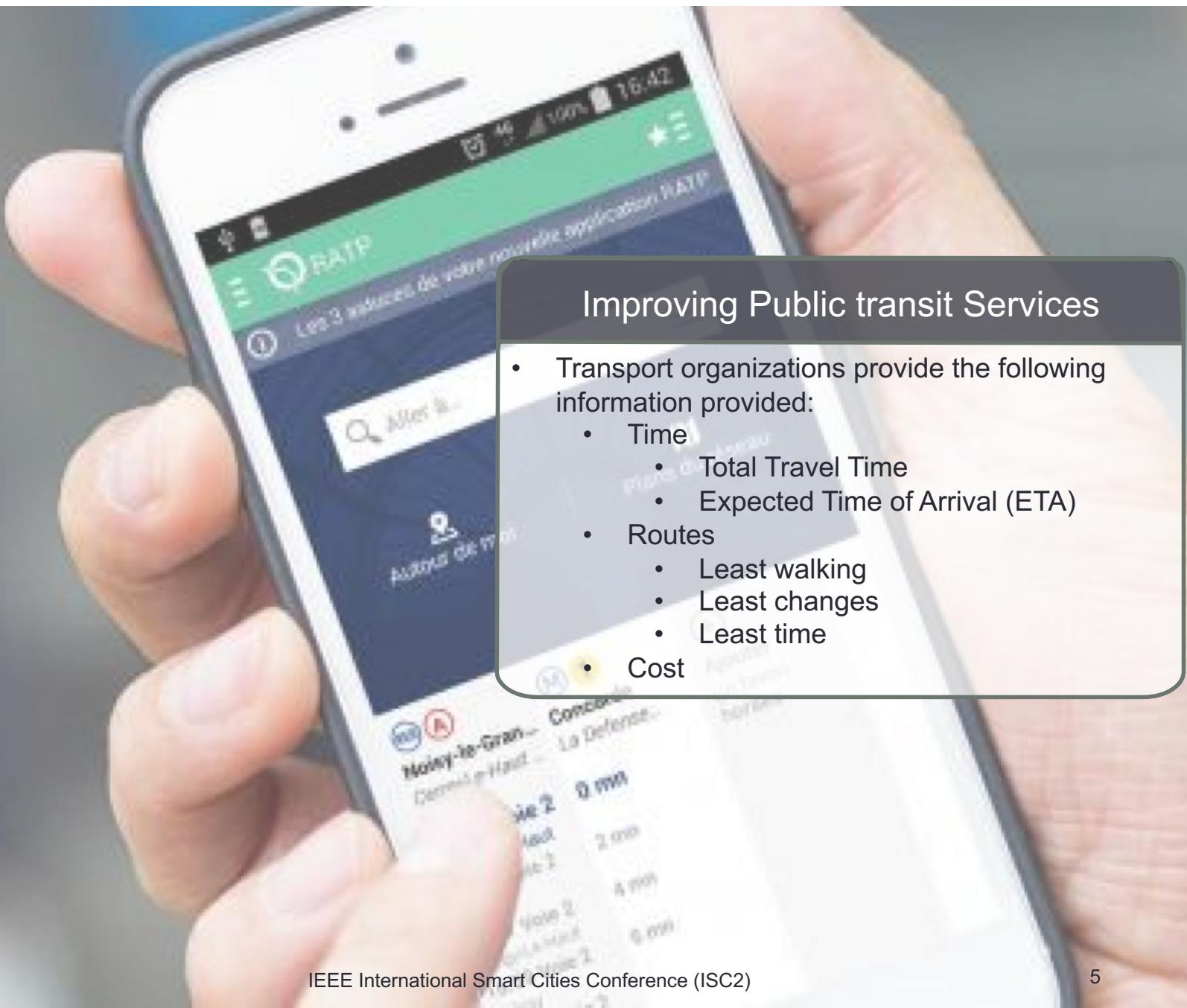
Increasing Transportation Demands

- With the rising population, transportation demands (especially in urban cities) also increase
- Public transport organizations provide multi-modal transit options to citizens to overcome the rising demands



Commuter experience in Public Transportation

- With increasing demands of public transportation
 - Crowdedness levels increase
 - Comfort levels decrease
- Difficult to motivate commuters to use public transportation



Improving Public transit Services

- Transport organizations provide the following information provided:
 - Time
 - Total Travel Time
 - Expected Time of Arrival (ETA)
 - Routes
 - Least walking
 - Least changes
 - Least time
 - Cost



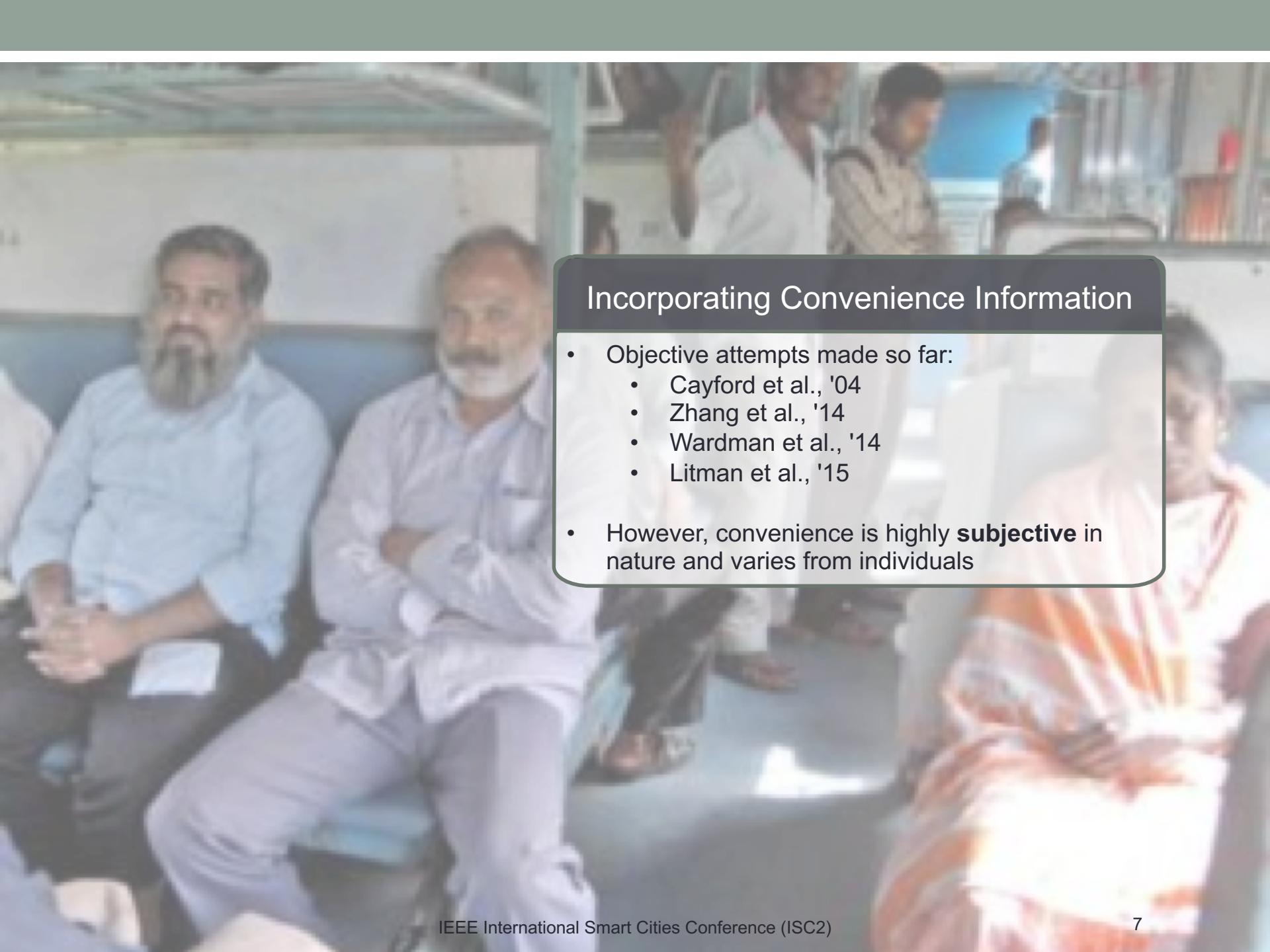
Improving Public transit Services

- Personalizing Commuter Experience
 - Ludwig et al. '09
 - Lathia et al., '10
 - Nakamura et al. '14
 - ...
- Incorporating extra commuter based information:
 - Commuter context
 - Historical travel information
 - Commuter interests (events, places, etc.)

Ludwig et al., 2009, "Recommendations of personalized routes with public transport connections"

Nakamura et al., 2014, "Toward personalized public transport recommendation systems with adaptive user interface"

Lathia et al., 2010, "Mining public transport usage for personalized intelligent transport systems"



Incorporating Convenience Information

- Objective attempts made so far:
 - Cayford et al., '04
 - Zhang et al., '14
 - Wardman et al., '14
 - Litman et al., '15
- However, convenience is highly **subjective** in nature and varies from individuals



Convenience Model: City-wide

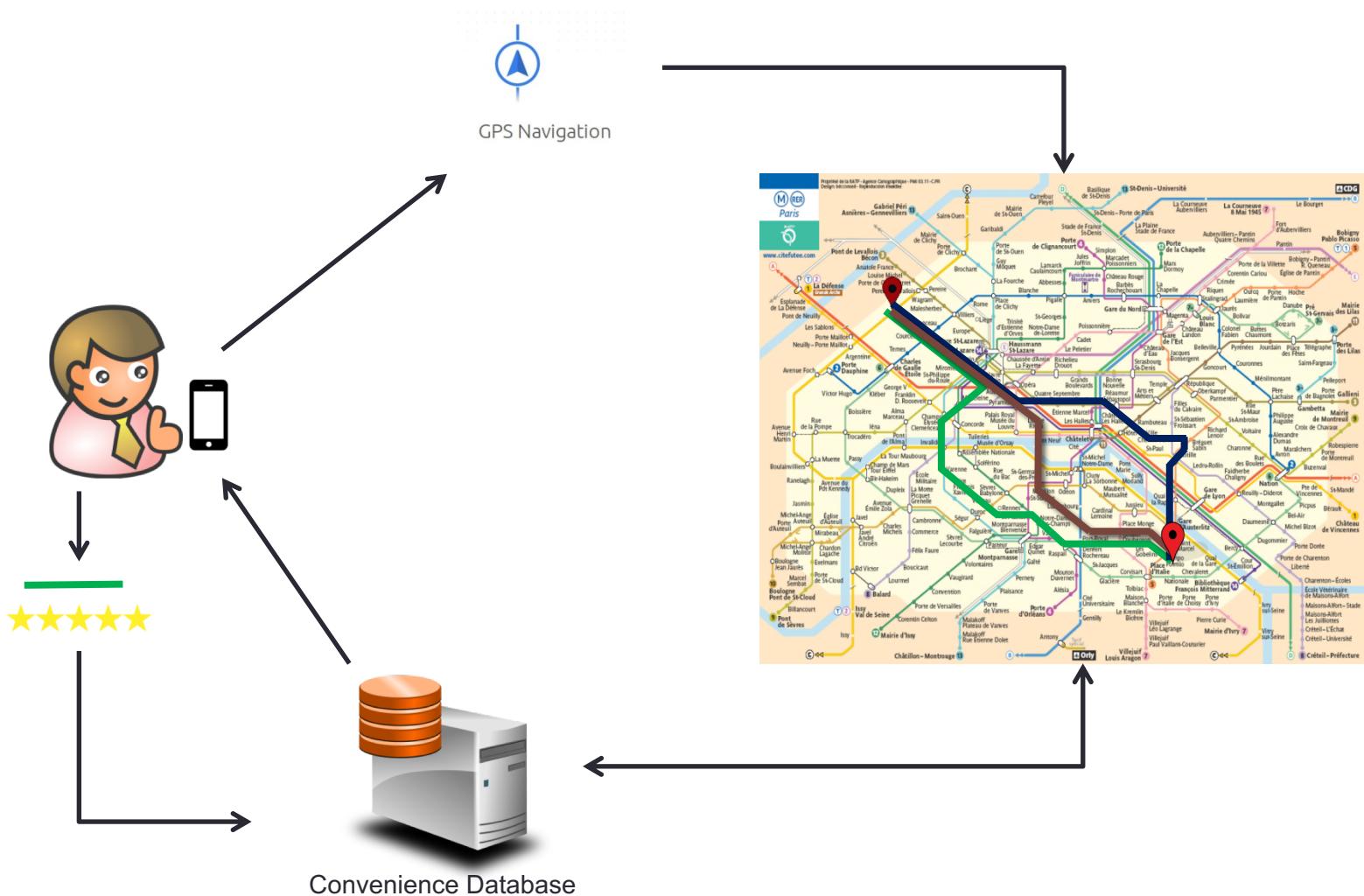
- Defined a model of convenience for different cities based on
 - Seat Availability
 - Waiting time
 - Crowdedness levels
- **Limited to Metro Travels only**

Bajaj et al., 2015, "Toward enabling Convenient Urban Transit through mobile crowdsensing"

Aim to define convenience of commuters on a subjective basis to personalize their public transit experience

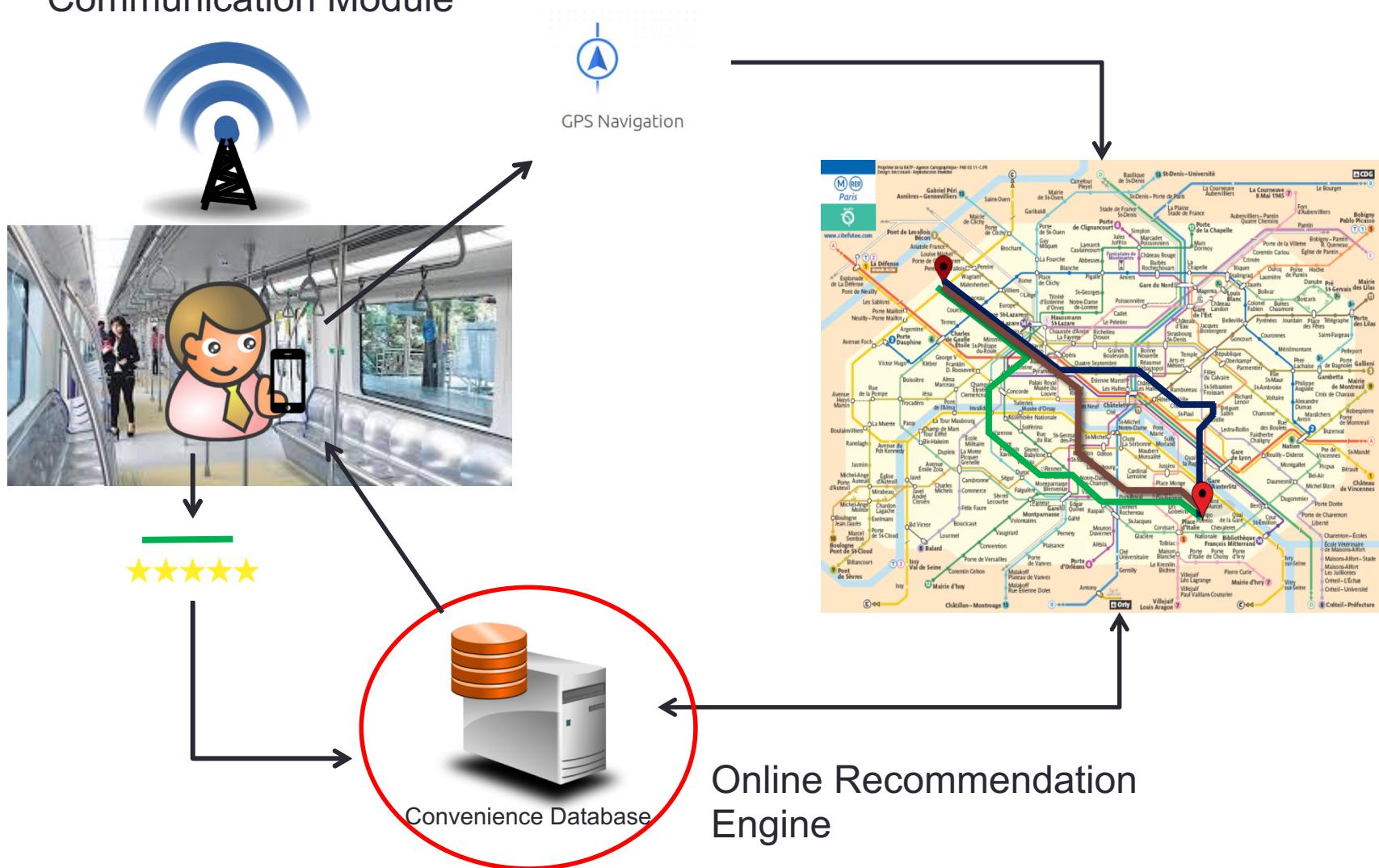


Proposed System: Sarathi



Components Required

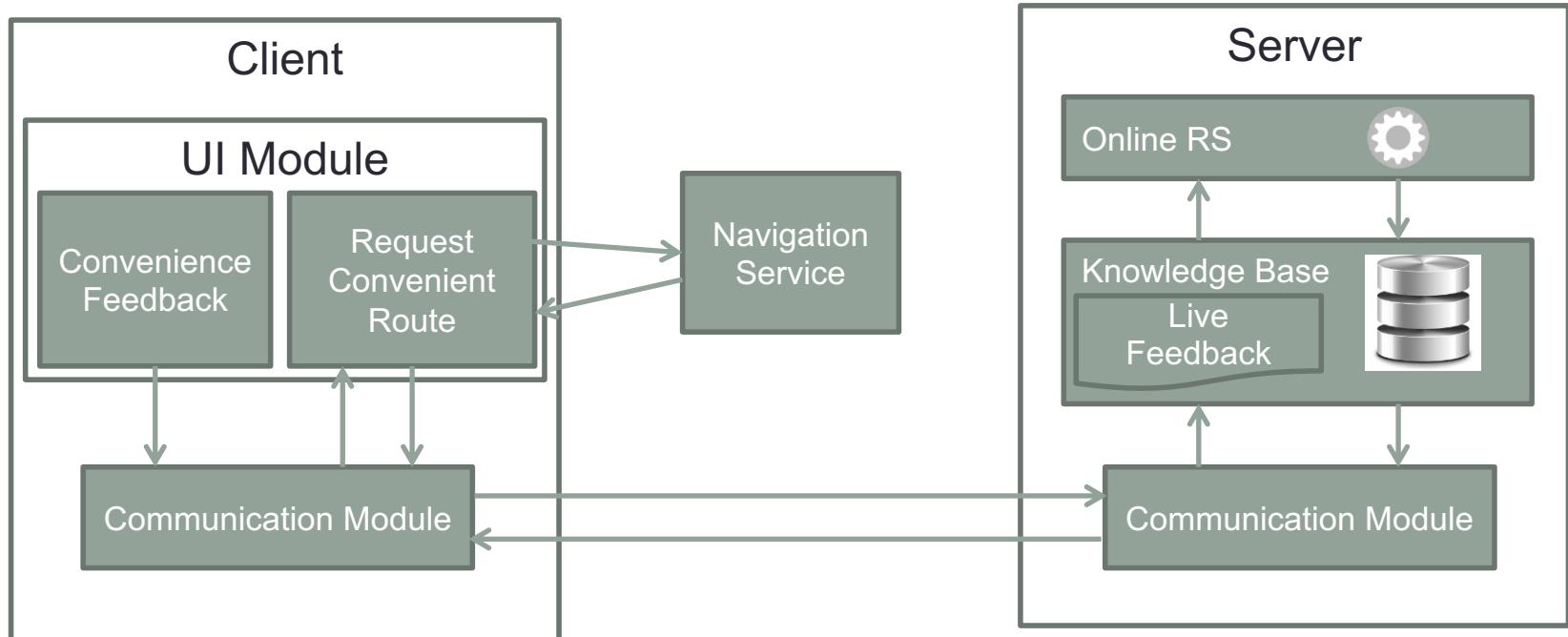
Communication Module



Communication Module: Implementation Details

- Messages may have different priorities
- Client-server interaction based on priority levels may be handled at a middleware level
- Possible interactions to be handled:
 1. **Synchronous client-server**
 - Route request made by client and server responds within a *timeout* period
 - Commuter has continuous network connectivity
 - COAP protocol
 2. **Asynchronous publish-subscribe**
 - Recommendation received by client within a *lifetime* period
 - Commuter has intermittent connectivity
 - RabbitMQ protocol
 3. **One-way Client-server**
 - Feedback submitted by the client
 - Delay is not crucial in submitting the feedback
 - COAP protocol
- Plan to design these interactions using Queueing Network Models
 - ON/OFF queues

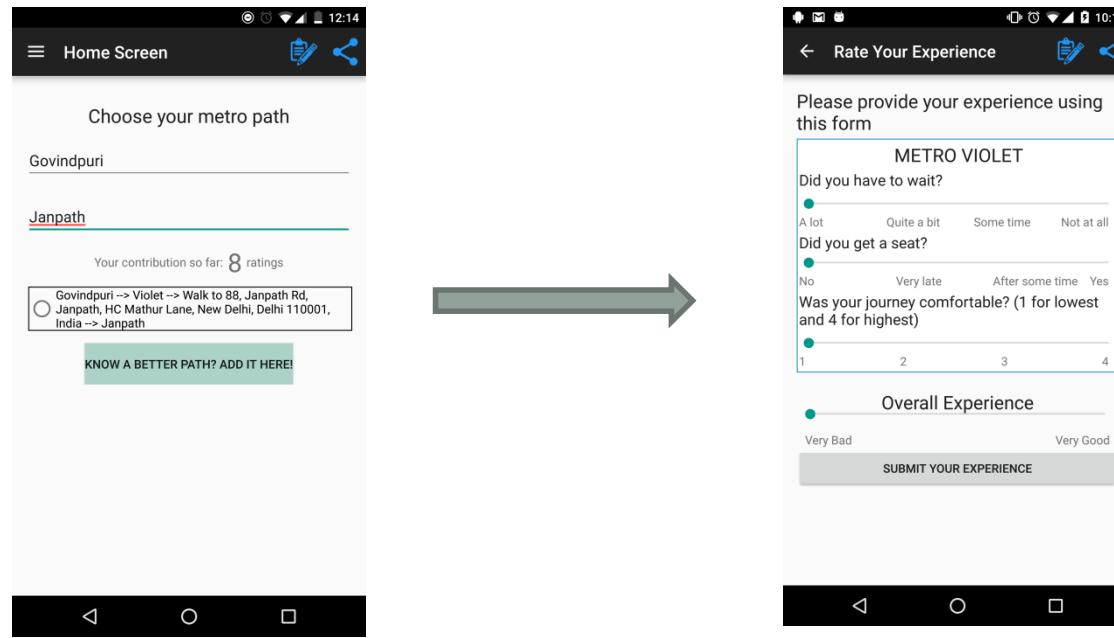
Sarathi System Architecture



Online Recommendation Engine

- Study to find the best recommendation engine for our application
- Choice of recommendation engines based on:
 1. Commuters may have similar preferences for convenience
 2. Convenience on routes may vary with time of the day
- Comparison between
 1. **User-based collaborative filtering:**
 - Based on k -NN
 2. **Probabilistic Matrix Factorization:**
 - Relies on latent features relating commuters to routes
 3. **Bayesian Tensor Matrix Factorization:**
 - Also considers time dependence of commuter convenience with different routes

Client App (Android): MetroCognition Server: GoFlow middleware



Thank you

Further information:

SARATHI: <https://sarathi.gitlab.io/web>