

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

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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

A blurred high-speed train, likely a Shinkansen, is shown in motion within a tunnel. The train is white with a red stripe. The background shows the curved structure of the tunnel and some lights. The image is used as a background for the presentation slide.

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"

A background image showing a group of people in a public space, possibly a waiting area or a community center. Two men are seated in the foreground, looking towards the camera. In the background, other people are standing and moving around. The image is slightly blurred, suggesting a candid shot.

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

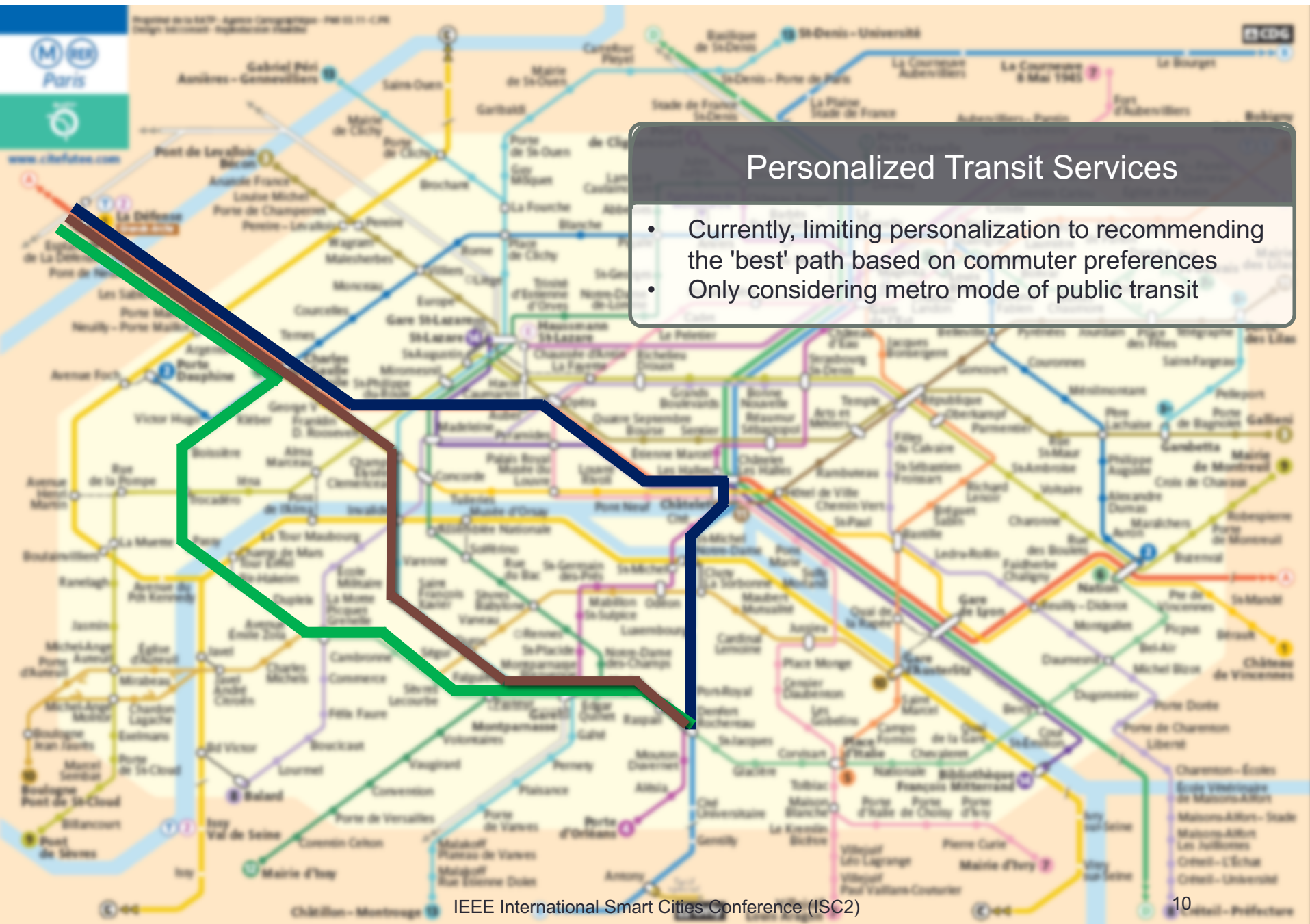


Convenience Model: City-wide

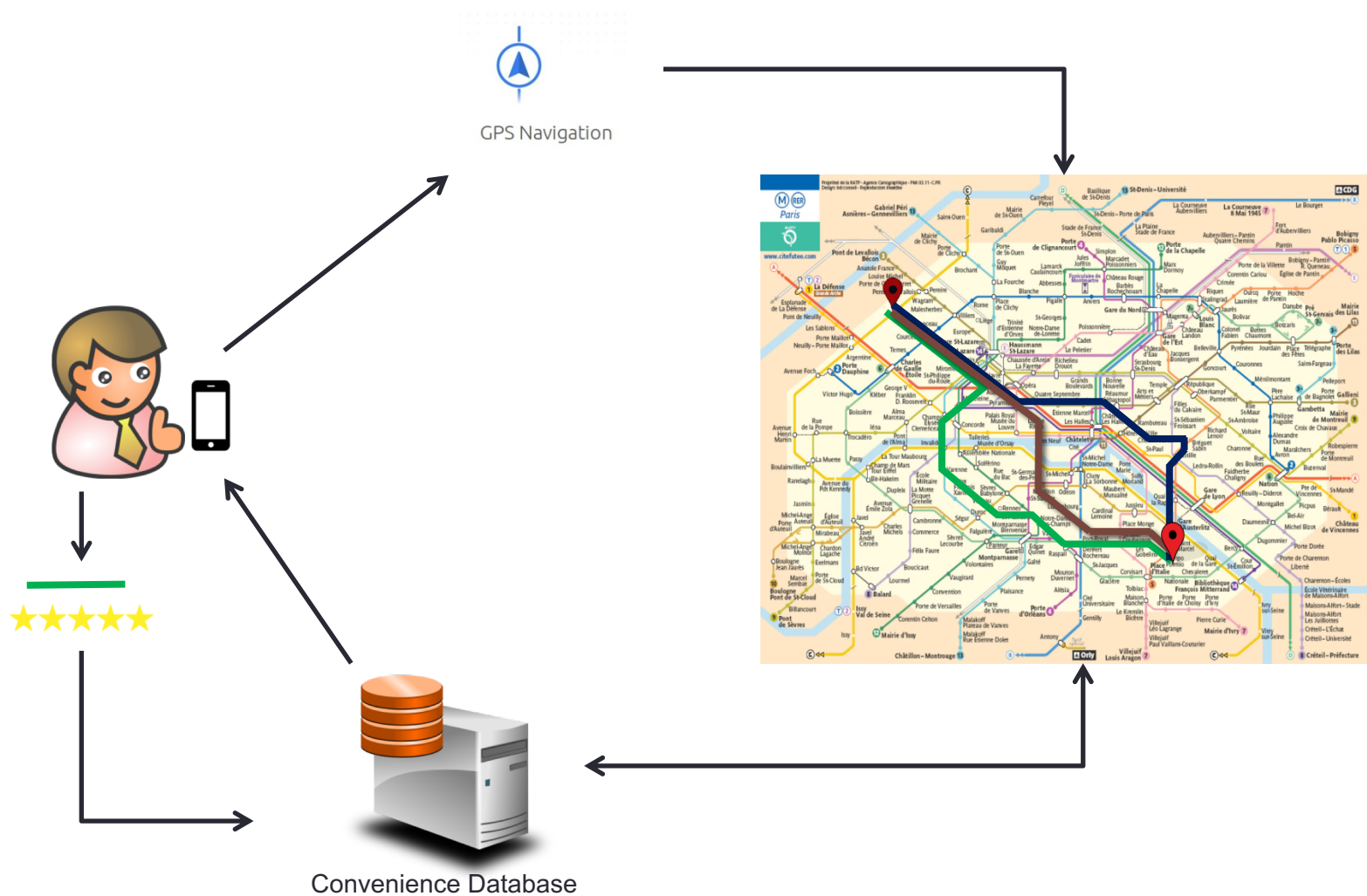
- Defined a model of convenience for different cities based on
 - Seat Availability
 - Waiting time
 - Crowdedness levels
- **Limited to Metro Travels only**

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

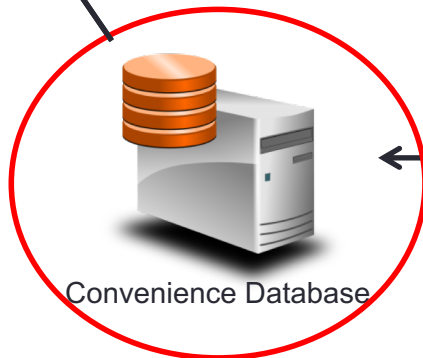


Components Required

Communication Module

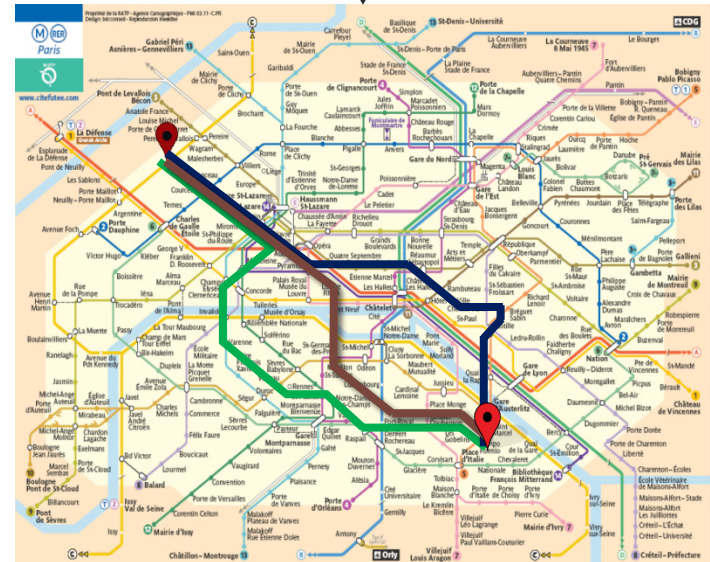


GPS Navigation



Convenience Database

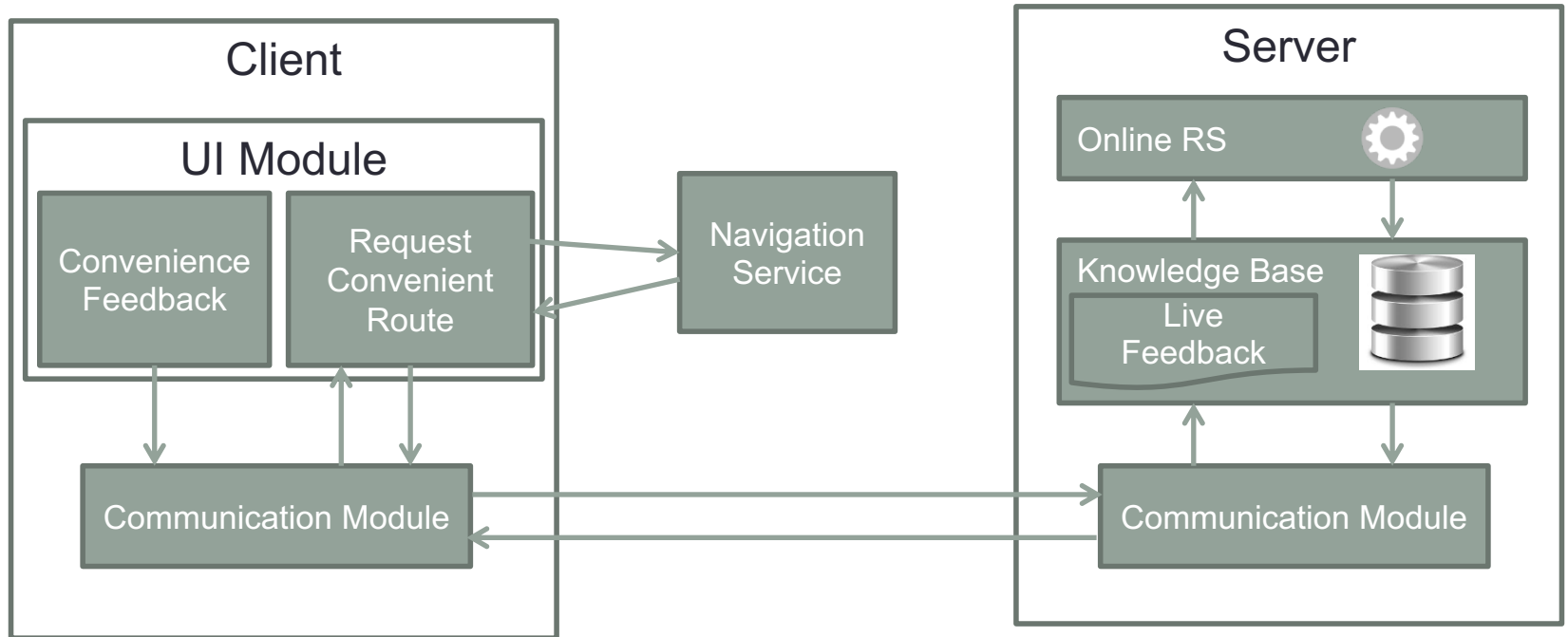
Online Recommendation Engine



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

Progress so far...

Client App (Android): **MetroCognition**
Server: **GoFlow middleware**

A screenshot of the MetroCognition app's Home Screen. The title bar says "Home Screen". The main heading is "Choose your metro path". Below it, there are two input fields: "Govindpuri" and "Janpath". Below the input fields, it says "Your contribution so far: 8 ratings". There is a list of paths with a radio button next to "Govindpuri -> Violet -> Walk to 88, Janpath Rd, Janpath, HC Mathur Lane, New Delhi, Delhi 110001, India -> Janpath". At the bottom, there is a green button that says "KNOW A BETTER PATH? ADD IT HERE!".

Home Screen

Choose your metro path

Govindpuri

Janpath

Your contribution so far: 8 ratings

☐ Govindpuri -> Violet -> Walk to 88, Janpath Rd, Janpath, HC Mathur Lane, New Delhi, Delhi 110001, India -> Janpath

KNOW A BETTER PATH? ADD IT HERE!

A screenshot of the MetroCognition app's Rate Your Experience screen. The title bar says "Rate Your Experience". The main heading is "Please provide your experience using this form". Below it, there is a section titled "METRO VIOLET". The first question is "Did you have to wait?" with a slider from "A lot" to "Not at all". The second question is "Did you get a seat?" with a slider from "No" to "Yes". The third question is "Was your journey comfortable? (1 for lowest and 4 for highest)" with a slider from 1 to 4. At the bottom, there is a section titled "Overall Experience" with a slider from "Very Bad" to "Very Good" and a button that says "SUBMIT YOUR EXPERIENCE".

Rate Your Experience

Please provide your experience using this form

METRO VIOLET

Did you have to wait?

A lot Quite a bit Some time Not at all

Did you get a seat?

No Very late After some time Yes

Was your journey comfortable? (1 for lowest and 4 for highest)

1 2 3 4

Overall Experience

Very Bad Very Good

SUBMIT YOUR EXPERIENCE

Thank you

Further information:

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