All-En-Route Functional Architecture and Architecture Principles

All-En-Route service platform will provide functionality for passengers, cab providers, business owner, management personnel, support personnel and kiosk operators. This will include user management, mapping services (map location and route), ride management, enroute food delivery, payment processing, business analytics, business management, platform management, administration, and customer (passenger and cab providers) support.
It will also take into consideration privacy and security, availability, responsiveness, performance, usability, and maintainability requirements that are essential for its promised functionality. The specifics of both these aspects are described in the document below.

1. Functionality for Passengers

1.1 Account management

Account management will provide registration, authentication, and profile management functionality.
For better **usability** or user experience, usual standard sign-up, login, logout, and profile management processes will be used.

1.1.1 Registration

After installing All-En-Route client, for registration process, passenger will need to enter name, user ID, phone, e-mail and optionally address details. The phone will be verified using OTP and e-mail will be verified using verification link. On successful verification, the Passenger details will be persisted in the registered passenger's database, where Personally Identifiable Information (PII) details will be encrypted before persisting. The passenger will then be presented with user interface to setup password. On successful setup, password will also be encrypted and persisted.

PII details and password will consistently be encrypted while in-transit as well as at-rest for **privacy** and **security** reasons.

1.1.2 Authentication

Successfully registered passengers will be able to login into the service platform using user ID and password credentials. The login credentials will be validated against registered passenger's database. On successful login, passengers will be presented with ride booking interface. On failure, error message will be displayed followed by login interface to reattempt login. Once logged-in, logout will take the logged-in passenger back to the login interface.

Credentials will be encrypted while in-transit for **privacy** and **security** reasons.

1.1.3 Profile management

Passenger will be able to setup and update the profile – for home, office and favorite locations addresses and payment methods, if any.

1.2 Mapping Services

The mapping services will provide for map view, location, route information and location tracking.
The mapping services must be **responsive** and should have low latency (< 10 seconds).
All-En-Route will integrate with a mapping service partner to provide location and route information. The interaction with the mapping service will be done by calling its platform interfaces.

1.2.1 Locations and routes

Ride booking interface will provide map view for locations and routes. Map view will display source (current or entered) and destination locations as markers on the map with route from source to destination. The platform will use reliable third-party mapping service interface. History of last 10 searches for destination will be made available for better **usability**.

1.2.2 Location tracking

Cab location before ride: The passenger will be able to track the assigned cab's location starting 5 minutes prior to the ride's scheduled start time.
Cab location during ride: The passenger will be able to track the cab's location during the ongoing ride. For **safety** reasons, passenger will also be able to share it with family or friends.

1.3 Ride management

Ride management functionality for passengers will provide for ride request creation, ride assignment notification and ride cancellation.
Availability of ride management services and mapping services (mentioned in 1.2 above), will be essential for passengers to be able to book rides **anytime anywhere across the country**.
The ride management operations must be **responsive** and should have low latency (< 30 seconds). Long running operations like ride assignment should keep the passenger updated of the ongoing status.

1.3.1 Ride request creation

Passengers will be able to use the mapping service to setup ride request by selecting source and destination locations, and optionally selecting number of passengers and luggage capacity required. The service platform will present route along with available cab types and pricing for the ride to the passenger. The passenger will then select from available cab types and pricing, set the ride time to now or schedule for later and create the ride request.

1.3.2 Ride assignment and notification

1.3.2.1 Regular ride assignment
The service platform will match available ride requests with available cabs with a timeout of 3 minutes applying location proximity starting from 0.5 km radius with an increase of 0.5 km every minute. The available cabs matching process will also incorporate passenger preferences selected, if any, mentioned in 1.3.1 above.

1.3.2.2 Long-distance-multi-driver ride assignment
The long-distance rides will follow regulatory requirements, if any. Rides estimated to be more than 4 hours will be treated as long distance rides. For long distance rides, after every 4 hours change of driver will be mandatory. The ride will be broken into segments of 4 hours with estimated start and end time-ranges and all ride segments will be assigned to appropriately matched cab providers. The best-effort ride request matching (minimizing cab switches) will have timeout of 10 minutes. Passenger will have an option to select "best-effort processing with 10 minutes wait time", and if not selected, normal matching with 3 minutes timeout will be performed.

1.3.2.3 Ride assignment notification
Once the ride is assigned, the service platform will notify the ride OTP and details of cab and driver to the passenger who requested that ride. The ride will be maintained in the upcoming rides for the passenger before start of the ride. The passenger will receive updates about changes, if any, regarding the assigned cab and driver. The passenger will be able to track the cab's location starting 5 minutes prior to the ride's start time.

1.3.3 Ride cancellation

Passenger will be allowed to cancel the ride request before it is assigned. In addition, passenger will be allowed to cancel the assigned ride 30 minutes before the scheduled start time for regular rides and 2 hours before the scheduled start time for long distance rides. Along with these time constraints, the cancellation must be accompanied with a valid reason from a pre-defined list. Otherwise, any ride cancellations will result in penalty of INR 200 or 10% of ride pricing, whichever is higher.
On cancellation of long-distance rides by passenger, the driver marks the finish of the current segment of the ride and passenger will be charged for completed segments of the ride along with delivered food orders (if any) and the penalty mentioned above.

1.4 Enroute food delivery option

The enroute food delivery service will only be available for long distance rides. The service platform will provide passengers with available food delivery stops (estimated time), food menu and delivery partner options available for their upcoming or ongoing long-distance ride route. The passengers will be able to choose food stop(s) and order food for enroute delivery.
All-En-Route will integrate with three food delivery service partners to fulfill the enroute food delivery service for the passengers. The interaction with the food delivery services will be done by calling their platform interfaces. The food delivery personnel will not access the All-En-Route service platform.

1.4.1 Food stops and options listing for ride route

Once the ride begins, the service platform will use mapping service interface to mark locations spanned at one-hour intervals from ride start time. The service platform will then use the food delivery partner platform interface to query availability of its food delivery service at each of these hourly locations. If there is a food delivery service available at an hourly location, it will be marked as a food stop. It will also determine the estimated arrival time-range of the cab at each food stop by adding 20 minutes (+/- 10 minutes) buffer. It will then query the interface of food delivery partner(s) for food menu(s) at each of the food stop locations.
It will provide passenger with this information of available food options and food stops, for getting enroute food delivery for their upcoming or ongoing rides.

1.4.2 Food order delivery functionality for ongoing ride

The passenger will select food from available options and order the food for delivery at specific food stops. The service platform will send the food delivery order to the food delivery partner using their interface and notify the passenger with confirmation status received. The delivered food order bill amount will be added to the ride cost.

If the food delivery service does not meet the specified delivery time-range, it will be imposed with a penalty of 5% of the food bill by All-En-Route. On the other hand, if the cab fails to arrive in a timely manner to pick up the food, All-En-Route will bear the 5% penalty of the food bill to compensate the food delivery partner.

1.5 Payments management

Passenger client interface will have the usual standard payment processing options available, as mentioned in the subsections below. Only digital payment options will be provided, cash payment will not be accepted.
Payment method details entered by passenger will not be stored and will be masked when displayed in the interface with masking characters (‘*’ or ‘x’) for **privacy** reasons. All the payment transaction records will be encrypted while in-transit as well as at-rest for **security** reasons.

1.5.1 Ride payments

The payment will need to be done once the ride is marked finished. Any pending penalty amounts (not yet paid by passenger) will be recovered along with the next ride payment.
UPI, digital wallet, net banking, credit/debit cards options will be made available to the passenger for the ride payment.
After successful payment, passengers will receive the invoice for their ride and penalty payments on their registered email.

1.5.2 Food delivery order payments

The payments for food delivery order(s) will be added to ride cost. Payments to food delivery partners will be settled by the service platform on daily basis.

2. Functionality for Cab providers

2.1 Account management

Account management will provide onboarding, authentication, and profile management functionality. For cab providers, onboarding will have regulatory verification requirements. The cab providers will need to sign contract agreeing to the terms and conditions specified in the contract.
For better **usability** or user experience, usual standard login, logout, and profile management processes will be used.

2.1.1 Onboarding

After installing All-En-Route client, for registration process, cab provider will need to enter driver details – name, user ID, phone, e-mail, address details, birth date, Aadhaar card, driving license, and health record details. Cab providers will also need to provide cab details – cab registration certificate, tax payment record, financial NoC (if applicable), cab type, seating and luggage capacity, cab maintenance records. The phone will be verified using OTP and e-mail will be verified using verification link. The rest of the driver and cab information will be verified by the All-En-Route system administrator as per regulatory requirements and approved accordingly. The cab providers will then need to sign contract agreeing to the terms and conditions specified. On successful verification and contract signing, cab and driver details will be persisted in registered cab providers database, where Personally Identifiable Information (PII) details will be encrypted before persisting. The cab provider will then be presented with interface to setup password. On successful setup encrypted password will also be persisted.

PII details and password will consistently be encrypted while in-transit as well as at-rest for **privacy** and **security** reasons.

2.1.2 Login and logout

Successfully onboarded cab providers will be able to login into the service platform using user ID and password credentials. The login credentials will be validated against onboarded cab providers database. On successful login, cab providers will be presented with interface to select and accept from available ride requests. On failure, error message will be displayed followed by login interface to reattempt login. Once logged-in, logout will take the logged-in cab provider back to the login interface.

Credentials will be encrypted while in-transit for **privacy** and **security** reasons.

2.1.3 Profile management

Cab providers will need to enter and be able to update their bank details to receive ride payments. Cab providers will also be able to update driver details – driving license and health records, as well as cab maintenance records and change in cab details, if any.

2.2 Mapping Services

Cab providers will be provided with map view of assigned ride source (passenger pickup location) and destination along with route and real time driving directions.
The mapping services must be **responsive** and should have low latency (< 10 seconds).

2.3 Ride management

Ride management functionality for cab providers will provide for ride assignment, ride processing and cancellation.
Availability of ride management services and mapping services (mentioned in 2.2 above), will be essential for cab providers to get rides assigned and be able to process the rides assigned **anytime anywhere across the country**.
For efficient ride assignments and processing, ride management and mapping services operations will need to be **responsive** (low latency).

2.3.1 Ride request assignment

2.3.1.1 Regular ride request matching
The service platform will match available ride requests with available cabs with a timeout of 3 minutes applying location proximity starting from 0.5 km radius with an increase of 0.5 km every minute. The available cabs matching process will also incorporate passenger preferences selected, if any, mentioned in 1.3.1 above.

2.3.1.2 Long-distance-multi-driver ride request matching
The long-distance rides will follow regulatory requirements, if any. Rides estimated to be more than 4 hours will be treated as long distance rides. For long distance rides, after every 4 hours change of driver will be mandatory. The ride will be broken into segments of 4 hours with estimated start and end time-ranges. These segment ride requests will have start time-range and end time-range instead of fixed time. The start time-range and end time-range will use 20 minutes (+/- 10 minutes) time buffer to accommodate early or delayed arrival from previous segment of the ride. During matching, to minimize cab switches, preference will be given to the cab providers who can pick all or most of the consecutive segments of the ride with required mandate of change of driver per segment of the ride. For the ride segments not picked as consecutive segments, matches will be performed just like the “regular ride matching” mentioned above in 2.3.1.1. In all conflict cases, first-come-first-serve criterion will be applied. The best-effort matching (minimizing cab switches) if opted for by passenger, will have timeout of 10 minutes. If passenger did not opt for best-effort matching, normal matching with 3 minutes timeout will be performed.

2.3.1.3 Ride request assignments
The matched cab providers will then be notified with the available ride requests (includes ride segments in case of long-distance rides). The cab provider will be able to select and accept one from available ride requests. The service platform will then assign the ride request to the cab provider using criteria as mentioned in 2.3.1.2. The cab provider will be then notified of ride assignment. The cab will be marked busy from the beginning of the ride until 5 minutes before the end time.

2.3.2 Ride processing

2.3.2.1 Regular ride request processing
For regular rides, the cab driver will mark the start of the ride using start OTP provided by the passenger and mark the finish of the ride, once the ride is completed, to trigger the payment process.

2.3.2.2 Long-distance-multi-driver ride request processing
In case of long-distance rides, the change of driver will happen after the segment of ride is completed by the current driver. A change of cab may also be needed if different cab providers are serving consecutive ride segments. Each driver will mark the finish for the segment of the ride completed by that driver. For the last segment of a long-distance ride, the segment finish will also mark the finish for the ride to trigger the payment process.

2.3.3 Ride cancellation

The cab provider will be allowed to cancel the ride 30 minutes before the scheduled start time for regular ride and 2 hours before the scheduled start time for long distance ride. Along with these time constraints, the cancellation must be accompanied with a valid reason from a pre-defined list. Otherwise, any ride cancellations will result in penalty of INR 200 or 10% of ride (segment) pricing, whichever is higher.
For long-distance rides, if cab provider cancels assigned segment(s) of the ride, the cab provider will be charged with the penalty mentioned above and All-En-Route service platform will replace the cab provider by performing prioritized re-matching of the cancelled segment(s) of the ride. The passenger will be kept informed of the replacement process status. If no replacement is found within 20 minutes of start of the cancelled segment, the passenger will have right to cancel rest of the ride segments without any penalty and All-En-Route will compensate the passenger with discount of 20% of remaining ride cost, for future rides.

2.4 Payments management

Payments to cab providers will be settled by the service platform on daily basis. The cab providers will receive consolidated statement for the rides completed and penalties (if any) for the day, on their registered email.
All the payment transaction records will be encrypted while in-transit as well as at-rest for **security** reasons.

3. Functionality for cab aggregator (business owner)

The business owner account will be pre-configured in the system and the business owner will need to change the password on first login. The service platform will provide executive dashboard for business owner. The business owner will be able to configure the dashboard with the required basic and analytical charts for aggregated metrics, dimensions, and time granularities of interest. The charts will be created using the outputs of the queries run against the archived data of the service platform.
The aggregated metrics (business measures) will include number of registered passengers, number of onboarded cab providers, rides served, and revenue numbers (total revenue, profit/loss). The dimensions will include locations (city or region), time-range of the day, cab type (hatchback, sedan, SUV), ride type (regular, long distance). The time granularities will include day, week, month, quarter, year and custom time range.
The executive dashboard functionality must provide for **usability** (user-friendly interface) and **configurability**.

3.1 Basic charts

The basic charts functionality will allow the business owner to choose the metrics, time granularity for metric aggregation and dimensions to create charts of interest. It will be a two dimensional chart of aggregated metrics vs dimensions.

3.2 Analytics charts

The analytics charts functionality will allow the business owner to create comparison (previous vs current quarter/year) charts and trend (most recent 12 months/4 quarters/5 years) charts.
It will also allow exploring the basic charts on an additional second dimension. This will enable the business owner to conduct a two-dimensional analysis of the business. For example, this will allow the business owner to explore the basic total-revenue-by-location chart further for specific locations on a second dimension such as cab-type.

3.3 Contracts and compliance information

The dashboard will also provide information on regulatory compliance statuses, business licenses with validity time frames, long-term partner service subscriptions or contract fees and renewal due dates.

Based on the insights collected from the analytical summaries presented in the charts, business owner will be able to make high level business decisions and set targets for quarterly and yearly business growth and revenues, which will then be communicated to the management and business development teams outside of the cab aggregation service platform.

4. Functionality for system administrator

The system administrator account will be pre-configured in the system and the system administrator will need to change the password on first login and will update the profile information.
The functionality for system administrator will include user (support, kiosk operator, cab provider) account management, service platform management (installs, configurations, upgrades and uninstalls).

4.1 User account management

The functionality will provide create, view, update and delete functionality for support users and kiosk operator accounts for the service platform.
Using this functionality, cab provider accounts reported to be non-compliant (by automated periodic regulatory checks) will be blocked and marked unavailable by system administrator. These cab providers will be notified and provided with grace period to comply with regulatory requirements before their accounts are permanently removed from the system by system administrator.

4.2 Service Platform Installation Management

This functionality will allow system administrator to install software on initial (or additional) hardware, apply required software upgrades, bug fixes and security patches for the service platform as well as uninstall if required.
The configuration functionality will include configuration of alert conditions for service platform health and resource capacity monitoring, configuration of frequency for automated periodic regulatory checks and configuration of data archival based on time limit.
The service platform will need to support **deployability** and **maintainability** with non-disruptive scaling and upgrades.

5. Functionality for customer support personnel

Customer (passenger/cab provider) issues will be handled by the customer support. The customer support personnel will be the first level of support and unresolved issues will be passed on to the second level of support handled by the technical support personnel.
The customer support personnel accounts will be created by system administrator. The usual standard login, logout and password update functionality will be provided to the customer support personnel.

5.1 Customer issue processing

Customer support personnel will have access to ongoing and completed rides and food orders from the current day as well as a one-week history of completed rides and food orders, to be able to address issues reported by passengers and cab providers.
Customer reported issues from service platform will be added to the current list of customer issues sorted with severity (high, medium, low) level assigned by customer. The issues will get assigned to customer support personnel based on their current workload. Customer support personnel will be able to view assigned issues, update it with resolution and mark it as resolved or forward it to technical support. Every change of status and resolution of the issues will be notified to respective customers.

5.2 Support knowledge base search

Customer support personnel will have interface to search knowledge base (KB) for the reported customer issues. On success, the issue will be resolved with the known resolution provided in the KB. Otherwise, the issue will be forwarded to technical support for further investigation and resolution.

Additionally, there is the potential to utilize chatbot and virtual assistant functionalities in customer support, which will then need to be responsive.

6. Functionality for technical support personnel

Issues that could not be resolved by customer support personnel will be forwarded to the technical support.
The technical support personnel accounts will be created by system administrator. The usual standard login, logout and password update functionality will be provided to the technical support personnel.

6.1 Customer issue processing

Technical support personnel will have access to ongoing and completed rides, food orders, customer feedback, and driver ratings, to be able to analyze and address customer (passenger/cab provider) issues.
Forwarded issues will be added to the current list of customer issues sorted with severity (high, medium, low) level assigned by customer. The issues will get assigned to technical support personnel based on their current workload. Technical support personnel will be able to view assigned issues, analyze and resolve the issues. Every change of status and resolution of the issues will be notified to respective customers. The issues that need a change in the service platform will be resolved as “will be addressed in upcoming upgrade or patch process” with more information if available at that point in time.

6.2 Support knowledge base update

Any issues resolved by technical support will be added to the knowledge base for future reference by customer support personnel.

7. Functionality for kiosk operators

The kiosks will be operated at heavy footfall locations like airports, railway stations, shopping malls and markets. The kiosk operator accounts will be created by system administrator. The usual standard login, logout and password update functionality will be provided to the kiosk operator.

7.1 Ride booking (with optional enroute food delivery) functionality

Ride booking and optional enroute food delivery will be performed by the operator on behalf of the passenger at kiosk, based on passenger inputs, as described in sections 1.3 and 1.4.
For such bookings, the passenger will need to pay 10% ride payment in advance.

8. References

[1] The Complete List of Indian Cab Ecosystem, features & technologies
[2] Fundamentals of Software Architecture: An Engineering Approach
[3] Business Analytics (BA): Everything You Need to Know
[4] Business Intelligence Dashboard: All You Need to Know
[5] What's A Sysadmin? The System Administrator Role Explained
[6] Technical support