



TransportGPT

Unlocking the full potential of Singapore's urban mobility with LLMs

A photograph of the Singapore skyline at sunset, featuring the Esplanade - Theatres on the Bay and the Marina Bay Sands hotel, with their reflections in the water. The image is partially obscured by a dark, semi-transparent overlay on the left side.

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Unlocking the full potential of
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Singapore's challenges regarding urban mobility today



High Population Density

Singapore's compact urban environment with its **high population density** puts significant pressure on its transportation infrastructure, leading to **overcrowding and strain on public transit systems**.



Traffic Congestion

Despite efforts to reduce car ownership, peak hour **traffic congestion remains a challenge**, affecting commute times and contributing to pollution.



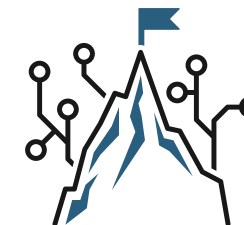
Public Transportation Inefficiency

Another challenge for organizations and authorities is to enhance **efficiency, reliability, and coverage of public transportation** to meet the needs of a growing population and reduce reliance on private vehicles.



Environmental Sustainability

Balancing urban mobility with environmental sustainability is a critical challenge. Prioritizing the reduction of carbon emissions and the encouragement of eco-friendly transportation choices are essential steps in striving towards a **Zero Waste Nation**.



Integration of Emerging Technologies

Incorporating **new technologies** (e.g., autonomous vehicles, electric scooters) and **leveraging tools like LLMs** on existing infrastructure while ensuring safety, efficiency, and accessibility for all users are of highest priority.

Large Language Models (LLMs) are powerful tools for complex analyses

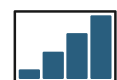
Powerful LLMs capabilities



Advanced Natural Language Understanding and Generation: LLMs can comprehend and produce human-like text, enabling complex interactions and content creation that rivals human output.



Versatile Applications Across Industries: From healthcare to finance, education, and legal, LLMs are revolutionizing how businesses and services operate, providing insights, automating tasks, and enhancing decision-making.



Continuous Learning and Improvement: With each interaction, LLMs learn and adapt, ensuring that their performance and relevance improve over time.

Success stories enabled by LLMs



ChatGPT



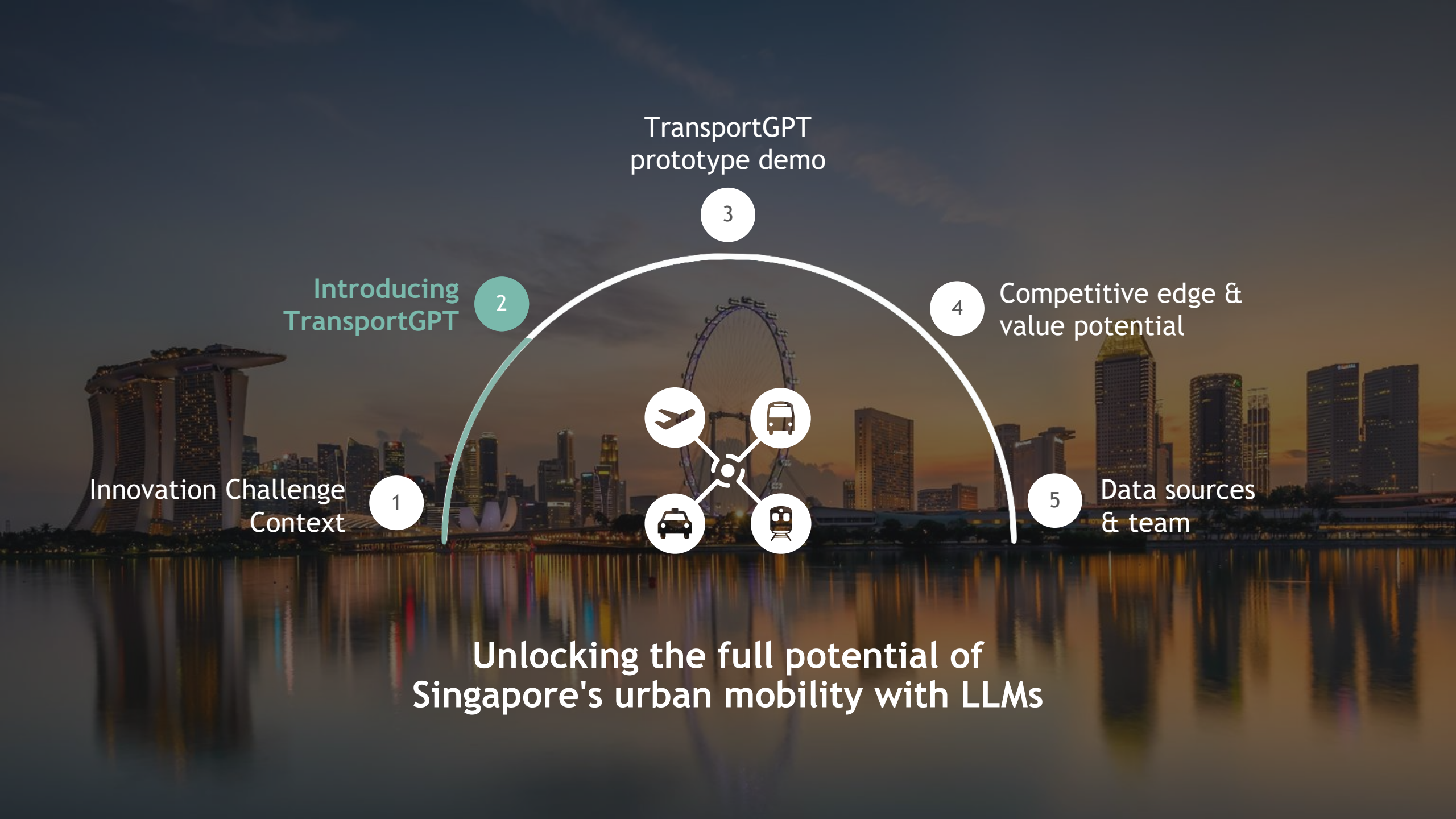
DeepL



**GitHub
Copilot**



Jasper



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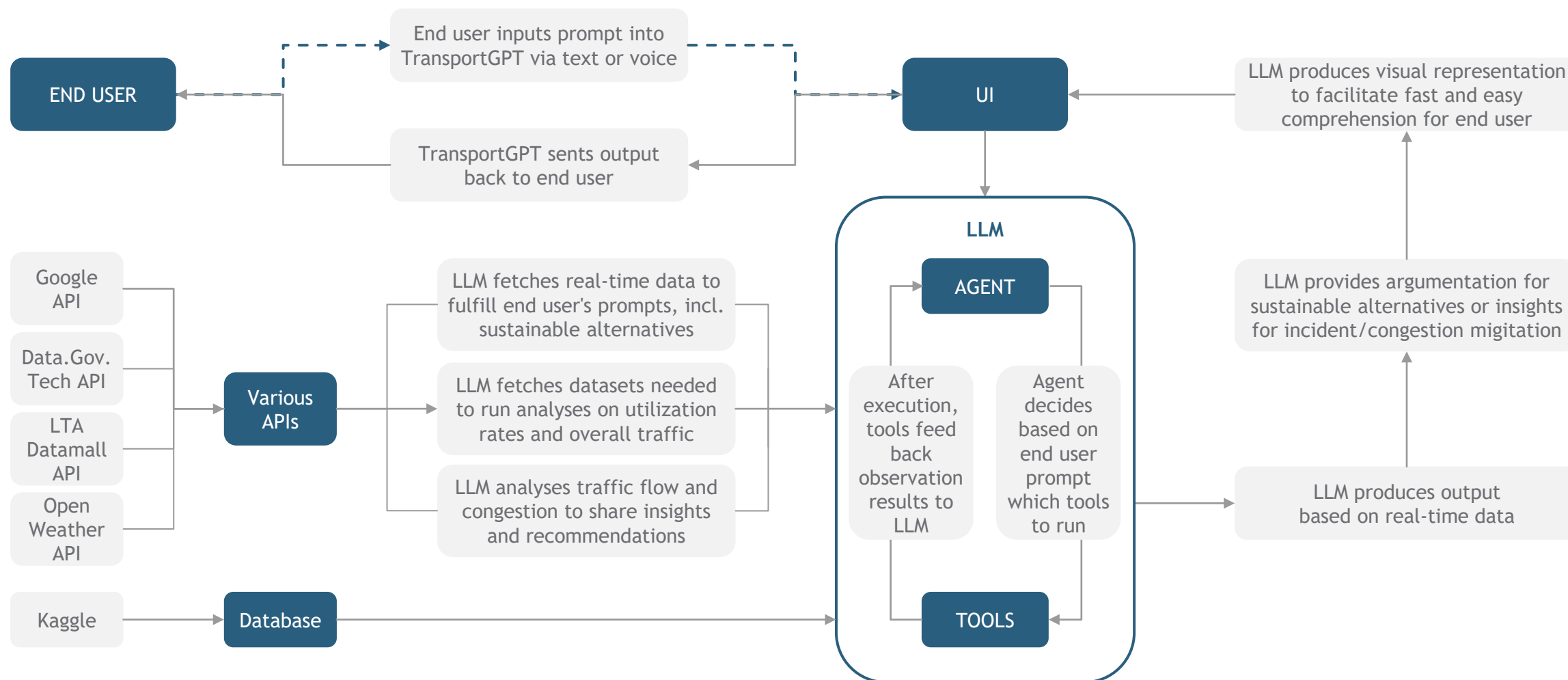
Two use cases for TransportGPT prototype's first two end users

USE CASE END USER	ROUTE PLANNING for Motorists and Commuters	TRAFFIC AND TRANSPORTATION MANAGEMENT for Mobility & Transportation Authority
PROMPTS & INTERACTION	<p>"I want to go to Marina Bay Sands by car. How do I get there the fastest way?"</p> <p>"Got it! And what is your start location?"</p> <p>"NUS Biz"</p>	<p>"Based on historic public transportation utilization, do I need to increase bus capacities today?"</p> <p>"Are you looking at specific MRT lines/bus no.?"</p> <p>"Yes, I want to analyse bus no. 188 please"</p>
TransportGPT & OUTPUT	<p>First output:</p> <ul style="list-style-type: none">• Fastest route from NUS Business School to Marina Bay Sands, considering current traffic conditions and incidents.• Parking availability at MBS and vacant parking options to users if any <p>Second output:</p> <ul style="list-style-type: none">• Sustainable travel alternatives, e.g. bus and then MRT to MBS,• including argumentation for public transportation, i.e. limited parking at MBS and congestion on highway, leading to faster ETA with public transportation	<p>LLM analyses:</p> <ul style="list-style-type: none">• Bus no. 188 utilization rate and capacity during operating hours for a default of 7 days by fetching data from relevant APIs• LLM detects patterns in the data, e.g. specific rush hours and capacities <p>Output:</p> <ul style="list-style-type: none">• Insight into rush hour demand and capacity constraints• Recommendation to increase capacities of bus no. 188 from 7 - 9am by deploying double-decker buses
MAIN OBJECTIVES	<p>Objective 1: Provide motorists and commuters with accurate, relevant and real-time information about their travel in Singapore</p> <p>Objective 2: Pro-actively encourage motorists to change to more sustainable travel alternatives by providing argumentation for those</p>	<p>Objective 1: Provide authorities with insights into Singapore's mobility and areas for improvement, by analysing all relevant historic and real-time data</p> <p>Objective 2: Pro-actively suggest measures to mitigate or address mobility issues, lowering the time and roadblocks to action</p>

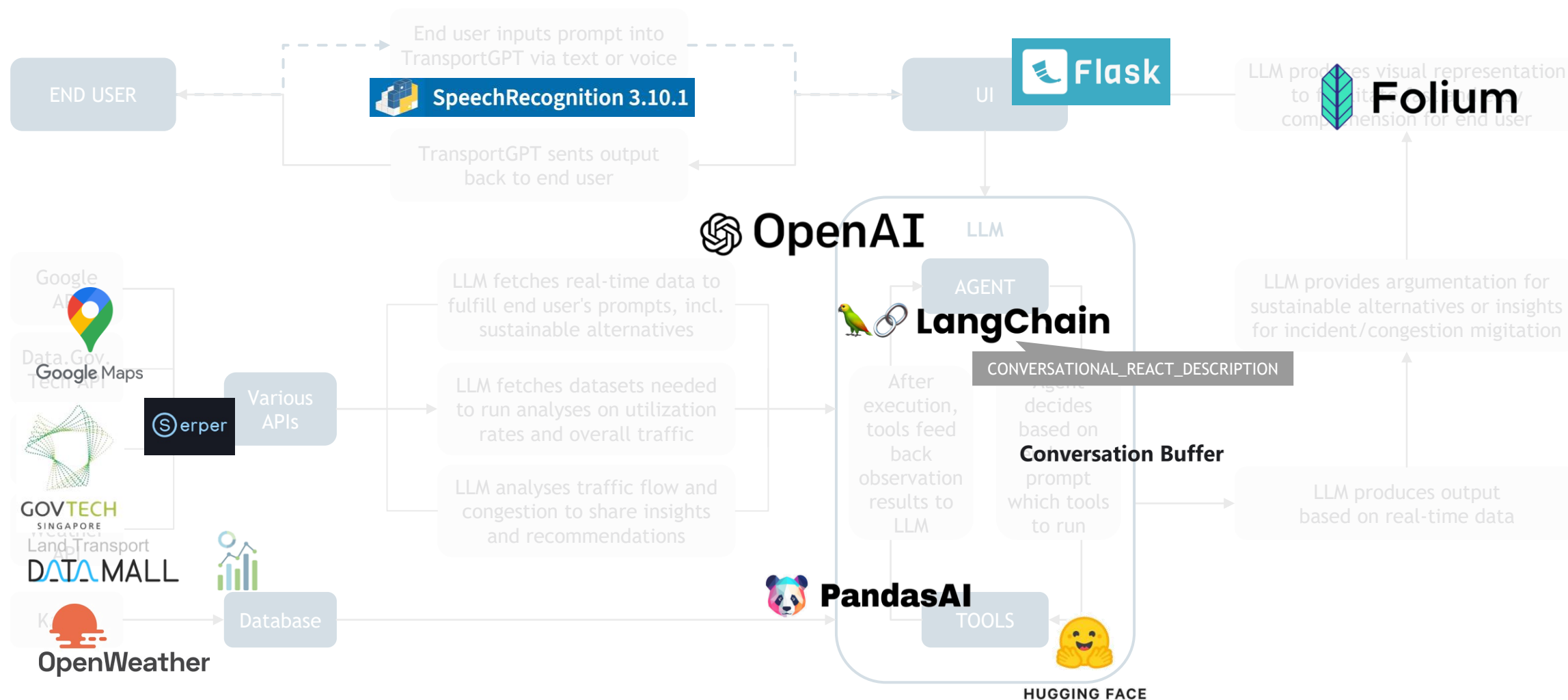
LLM-powered TransportGPT takes Singapore's urban mobility to the next level

GPT Layers		GPT Features
Data Layer	Real-time Data Integration	TransportGPT connects to various APIs to fetch real-time data on optimal travel routes, traffic conditions and incidents, public transportation capacities, parking availability, and weather conditions to ensure current, accurate and holistic information at all times.
	Data Analysis and Comprehension	The model is trained to comprehend and analyse vast and varied data types and structures. This allows TransportGPT to understand complex information from multiple sources and leverage it effectively to provide travel recommendations for each user.
Model Layer	Dynamic Natural Language Interaction	TransportGPT seamlessly interprets user prompts in natural language, fostering intuitive and dynamic engagement. Its interactive interface facilitates real-time interaction, delivering relevant responses and enhancing overall usability.
	Inclusive Voice-to-Text Capability	With voice-to-text functionality, TransportGPT caters to drivers, allowing them to interact with the system hands-free while driving. This feature ensures safety and convenience for users seeking route guidance or traffic updates during their journey.
	Inclusive Map Visualization	TransportGPT integrates map visualization, offering users not just text-based route options but also visual maps. This feature enhances the user experience by providing clear and easy-to-understand navigation aids.
	Data-driven Sustainable Alternatives	TransportGPT suggests sustainable travel alternatives based on real-time data, promoting greener options like public transport in response to factors such as limited parking and road congestion. By providing reasoned arguments, the system educates and encourages users to choose more environmentally friendly travel options.
	Traffic and Public Transport Utilization Alerts	By detecting increases in traffic congestion or public transportation usage, TransportGPT can alert transportation authorities for timely intervention. This feature aims to facilitate swift action to mitigate congestion and enhance public transport services.
Generative App Layer		

Lean flowchart of TransportGPT's is designed for fast and accurate responses



Lean flowchart of TransportGPT's is designed for fast and accurate responses



Technical performance in terms of response time and accuracy

	ROUTE PLANNING	TRAFFIC AND ROAD MANAGEMENT
Current latency	<p>For driving:</p> <ul style="list-style-type: none">live road conditions analysis: 15-20 secondscarpark availability and traffic incidents: 10 seconds <p>For walking and public transportation:</p> <ul style="list-style-type: none">weather and train service alert: 2-3 secondsroute planning: 2 seconds <p>For map visualisations:</p> <ul style="list-style-type: none">10 seconds (for traffic incidents)	<p>For traffic summary:</p> <ul style="list-style-type: none">traffic summary description: 1-2 secondsperform data analysis on train and bus stations: 7-15 seconds <p>For graph visualisations:</p> <ul style="list-style-type: none">5-10 seconds (for both train and bus stations)
Strengths	<ul style="list-style-type: none">Able to seek clarifications from users following ambiguous inputsAble to retrieve chat history to understand users' subsequent requestsAble to seek relevant tools to respond to users' questionsRecommend eco-friendly commuting options which promotes sustainability journey aligning to LTA's Green Plan 2024	<ul style="list-style-type: none">Able to provide concise summary of the traffic conditions from real-time dataAble to analyse historic data to provide insights on passenger volumes in the past month (e.g. identify the bus stop with the least volume on weekday)Provide visualisation for trends analysis
Current weaknesses	<ul style="list-style-type: none">Occasionally provides repetitive responsesMay be overly insistent on encouraging users to choose sustainable travel options, as it tends to suggest public transport repeatedly before providing a driving routeAble to carry out calculations but needs more training to calibrate the judgement of numerical measurements	<ul style="list-style-type: none">Extracting out information from the dataframe might not be 100% accurateAlthough TransportGPT provides flexibility for users to plot the graphs based on type of day, type of station, and type of volume, more graph variations could be employed to provide a deeper analysis (more training needed)

TransportGPT prototype demo



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Route planning demonstration |

TransportGPT fulfills user's prompts and advises on sustainable alternative

TransportGPT
Ask me anything!

hey hey :D 12:2

Hello! How can I assist you with route planning and weather information in Singapore? 12:3

thinking to drive from marina bay sands to vivo city 12:2


Based on the current traffic conditions and the number of available lots in the nearby carparks, driving may not be the most efficient and sustainable option. There are currently 276 taxis available within 3km, so taking a taxi would be a more eco-friendly option. Additionally, there are roadworks on Keppel Road which may cause delays. I would recommend taking public transport, such as the bus or MRT, as it is a more sustainable option and there are many available options nearby.

how many car parks are there in vivo city? 12:3

There are several car parks in VivoCity, including VivoCity P2, VivoCity P3, and Harbourfront Centre. According to the latest data, there are a total of 2026 available lots in these car parks. Would you like me to suggest a route for you to get to VivoCity?

nicieee can u show me the map 12:6

Here is your map:



TransportGPT
Ask me anything!

how many traffic incidents along the way again 12:9

There are currently 3 traffic incidents along the way from Marina Bay Sands to VivoCity. These include roadworks on Keppel Road, a vehicle breakdown on Telok Blangah Road, and a minor accident on West Coast Highway. Would you like me to provide more details on these incidents?

hmm not sure if i should drive then :C 12:9

Based on the current traffic conditions and the number of available lots in the nearby carparks, driving may not be the most efficient and sustainable option. There are currently 276 taxis available within 3km, so taking a taxi would be a more eco-friendly option. Additionally, there are roadworks on Keppel Road which may cause delays. I would recommend taking public transport, such as the bus or MRT, as it is a more sustainable option and there are many available options nearby. Would you like me to suggest a route for you to get to VivoCity?

ok ... can u describe the live traffic conditions as well? from the traffic cams 12:10

There are several traffic cameras along the way from Marina Bay Sands to VivoCity. According to my observation, the Marina South Pier Station has a close-up view of a street with a sign on the side, the Marina Coastal Drive has an aerial view of a highway with multiple lanes and a traffic camera, the Straits Boulevard has an aerial view of a city street with a yellow arrow pointing to the right, and the Keppel Road has a view of a truck driving down the highway. Based on the traffic volume and the number of available lots in the nearby carparks, it seems that the roads are currently quite crowded. To avoid the traffic congestion, I would suggest taking public transport, such as the bus or MRT, as it is a more sustainable option and there are many available options nearby. Would you like me to suggest a specific route for you?

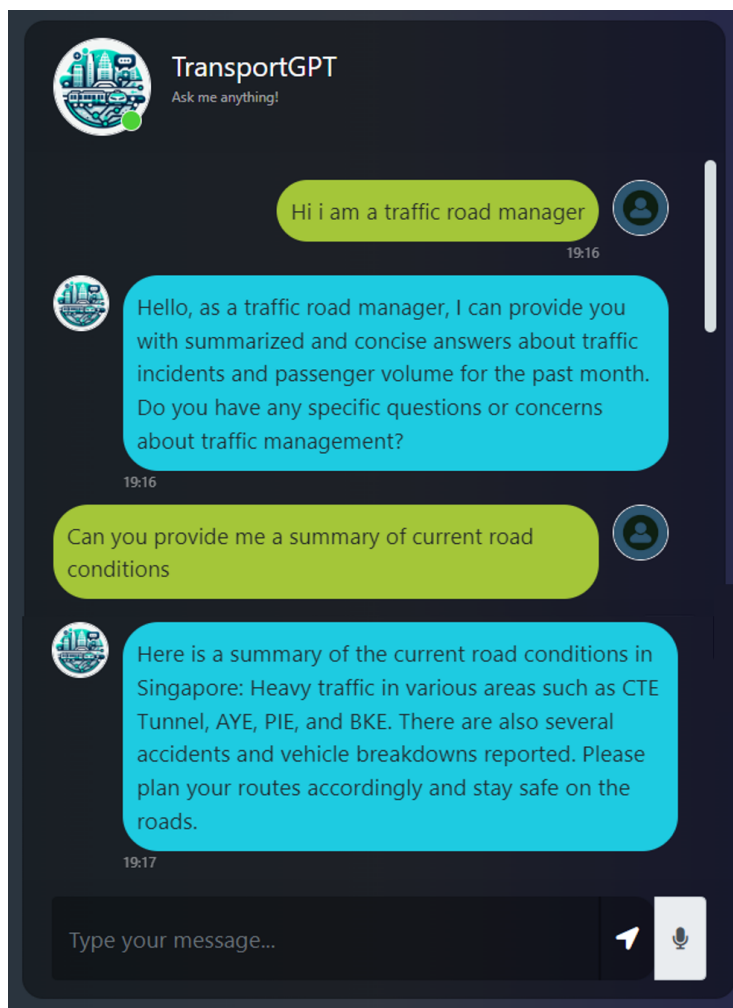
yes how can i get there by bus? 12:11

Sure, here is the route for you to take public transport from Marina Bay Sands to VivoCity: 1. Walk to the nearest bus stop, Marina Bay Sands Hotel (03501), which is about a 3-minute walk from your current location. 2. Take bus 97 from Marina Bay Sands Hotel (03501) to Opp The Sail (03381), which is about a 10-minute ride. 3. Walk to the nearest MRT station, Raffles Place (EW14/NS26), which is about a 5-minute walk from Opp The Sail (03381). 4. Take the East-West Line towards Tuas Link (EW33) and alight at Outram Park (EW16/NE3), which is about a 3-minute ride. 5. Transfer to the North-East Line towards Punggol (NE17) and alight at HarbourFront (NE1/CC29), which is about a 5-minute ride. 6. Walk to VivoCity, which is about a 5-minute walk from HarbourFront (NE1/CC29). As for the current weather conditions, it is currently partly cloudy with a temperature of 28°C. There may be some

Type your message...

Traffic and road management demonstration |

TransportGPT analyses traffic & transportation data to share insights with user





TransportGPT uses
a well-defined
thought process to
dynamically interact
with the user

Based on the users' prompt and chat history, TransportGPT will follow the following process

- ask user for additional information if necessary for responding or if ambiguous
- provide additional information relevant for requested travel mode, e.g.
 - parking availability at destination and road incidents along the route for motorists,
 - weather conditions being (not) ideal for walking or biking etc.
- extract real-time road conditions from images captured by traffic cameras for more accurate responses and traffic flow analyses
- ask user if they are interested in sustainable modes and then provide sustainable travel routes incl. data-driven argumentation,
 - e.g. shorter ETA with public transportation due to high congestion,
 - limited parking availability at destination etc.
- praise user when they are choosing sustainable travel modes, e.g.
 - by stating the environmental friendliness of Singapore's public transportation system and the health benefits of walking
- provide the count of the available taxis within a 3km radius enables them to estimate their waiting time effectively and to encourage the use of taxis over personal vehicles, thereby mitigating congestion and emissions
- suggest taxi usage as an alternative if user encounters limitations with public transportation
- enable quick dissemination of information to relevant stakeholders, facilitating timely interventions and mitigation measures to minimize congestion when necessary
 - provide real-time alerts to road traffic manager about potential delays in traffic due to roadworks and vehicle breakdowns
 - analyse (historic) transportation data to extract insights and patterns from vast amount of unstructured data

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TransportGPT unlocks value compared to current alternatives on the market

TransportGPT's evaluation criteria		Benchmark analysis against TransportGPTs competitors / alternatives		
Performance evaluation	Transport GPT	ChatGPT 3.5	Google Maps	CityMapper
Data Sources e.g. comprehensive and real-time data	Connected to various APIs to fetch comprehensive real-time data on traffic conditions, incidents, public transportation utilization, parking, weather etc. in Singapore	No access to Singapore's urban mobility APIs, hence, relying on available internet sources (which are limited accessible and likely outdated) to respond to requests	Does not have access to Singapore's traffic APIs directly. Hence, only reports traffic congestion based on users' GPS data	Does not provide information for all available transportation modes; mainly focuses on public transportation
Response quality <i>measured by accuracy and relevance</i>	Highest response quality as the only tool specific to Singapore traffic incl. all transportation modes; analyses traffic conditions and offering visualizations as well	Responses' accuracy and relevance underperform compared to competitors; further, limited visualization for route planning; insightful analyses into traffic only possible after building custom GPT	High response quality and accuracy for travel routes; however, limited in allowing user to share personalized prompts or more complex requests; no analyses of traffic conditions for public authorities	Also suggests public transportation routes with >3 interchanges (inconvenient and exhausting experiences); Does not allow personalized prompts; no insightful analyses into public transport utilization
Technical performance <i>e.g. latency, throughput, availability etc.</i>	Slower response time than competitors as currently run on local servers with lower computing power; with professional rollout, techn. performance on par with competitors	Fast response time with only occasional unavailability	Fast response and high availability	Fast response and high availability
Responsible AI <i>e.g. level of sustainable travel alternatives encouraged</i>	TransportGPT encourages end users to choose more sustainable travel routes by providing argumentation for those, considering ETA, weather, traffic conditions	Does not proactively suggest and encourage user to opt for more sustainable travel routes	Displays different transportation modes generally with high-level information such as route and ETA; however, does not provide argumentation or encouragement for users to choose most sustainable option	Does provide high-level information on walking and cycling, however, does not provide argumentation to choose those alternatives
Business Impact <i>in terms of value created for travellers and authorities</i>	Will achieve high customer satisfaction with most accurate and relevant responses for Singaporean commuters; High ROI and cost savings thanks to insightful analyses enabling traffic issue mitigation and strategies	Due to limited access to SG real-time traffic data, cannot offer accurate travel routes for commuters; need to upload sensitive data into ChatGPT to enable insightful analyses for authorities to mitigate or address issues	High customer satisfaction due to accurate route planning; for transportation authorities, no analyses available to enable traffic issue mitigation, hence, no ROI or reduced cost	High satisfaction for public transportation commuters due to accurate MRT and bus arrival times; not helpful for other transportation modes; no analyses for traffic authorities
Best solution today				

Advanced LLM-features can unlock even more potential in future development



Roll-out of TransportGPT

Global rollout followed by best-practice-repository

Cloud-based global rollout of TransportGPT to enhance other city's mobility;
World-wide collection of transportation best practices and insights into a repository for participating authorities to choose from and implement

Integration into car systems for green wave & light

TransportGPT integration into car systems (similar to Car Play) allows real-time analysis of traffic flow and green-wave routes, enabling more accurate traffic flow analyses and dynamic green traffic light scheduling according to real-time flow and congestion

Seamless & quick data integration with no downtime

Plug-in of more APIs and other data sources can be executed immediately with no downtime for TransportGPT users, while allowing developers to refine and implement data points into analyses



Enhancement of public transportation

Dynamic scheduling enabling faster commutes

TransportGPT analyses vast amount of data to enable real-time dynamic scheduling of public transportation (according to fluctuating demand) and implement speed trains (e.g. every third MRT only stopping in main demand stations)

Pro-active recommendation of mitigation strategies

After observing patterns in the data, TransportGPT does not only share the insights but goes one step further and proactively suggests measures to address issues, e.g. deploy double-decker buses for bus 188 during 7-9am and 5.30 - 7.15pm

45-minute commutes between any points in SG

TransportGPT detects any public transportation route within Singapore taking over 45-minutes and identifies root causes as well as defines specific solutions, e.g. speed MRTs for green line, bus-only lanes and traffic lights on Pasir Panjang, new bus routes etc.



Acceleration towards a greener Singapore

Identification of eco-friendly routes for motorists

TransportGPT analyses road network and identifies eco-friendly roads and routes for motorists and taxi drivers (routes on which motored vehicles will emit fewer carbon)
(Google does not offer this feature for Singapore yet)

Construction of EV-charging station network

TransportGPT records current EV-charging stations to recommend to searching users; Further, analyses and recommendation of potential locations to implement more stations can increasingly incentivize EV purchase and usage due to broader & more convenient network

Green (traffic light) wave for motorists

TransportGPT analyses traffic light data and road and traffic conditions to recommend route and specific driving speed to motorists to maximize green lights during their commute; TransportGPT could offer slow and fast speed options

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Sources and tools used to build innovative TransportGPT

DATA SOURCES LEVERAGED:

- Google API
- LTA Datamall APIs for following datasets:
 - Traffic Incidents, Accidents, Road work and Vehicle Breakdown, and Traffic Diversions
 - Traffic images
 - Car Parking Availability
 - Taxi Availability
 - Passenger volume for train stations and bus stops
 - Weather
- Data.Gov.Tech API
- OpenWeather API
- Serper API
- Kaggle for train station codes and names

TOOLS DEPLOYED DURING DEVELOPMENT:

- LangChain, incl.
 - CONVERSATIONAL_REACT_DESCRIPTION
 - Conversational Buffer
- OpenAI
- PandasAI
- Hugging Face
- SpeechRecognition 3.10.1
- Flask
- Folium



The developers of
TransportGPT from
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A night-time photograph of the Singapore skyline, featuring the Marina Bay Sands hotel on the left, the Singapore Flyer in the center, and various skyscrapers on the right. The city lights are reflected in the water in the foreground. The sky is dark with some clouds.

Thank you for your attention!

Please reach out to the team in case of any questions.