



# Smart Cities: How Big Data is the way ahead

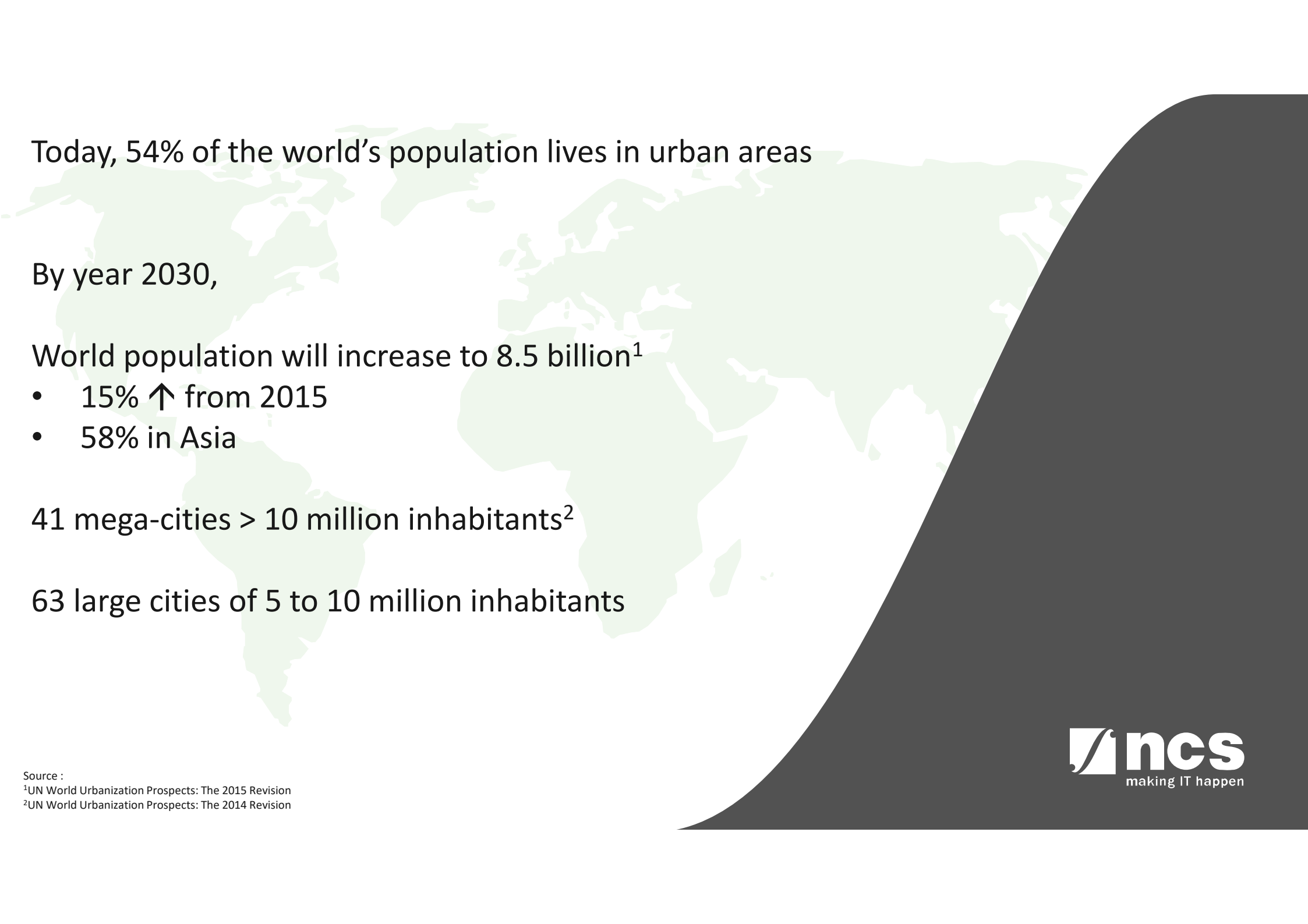
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22 Feb 2017

Session A3

Hall 1





Today, 54% of the world's population lives in urban areas

By year 2030,

World population will increase to 8.5 billion<sup>1</sup>

- 15% ↑ from 2015
- 58% in Asia

41 mega-cities > 10 million inhabitants<sup>2</sup>

63 large cities of 5 to 10 million inhabitants

Source :

<sup>1</sup>UN World Urbanization Prospects: The 2015 Revision

<sup>2</sup>UN World Urbanization Prospects: The 2014 Revision

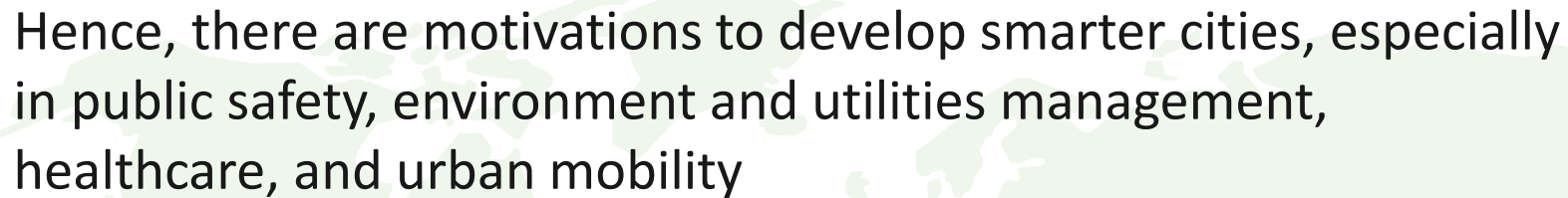


Globally,

Life expectancy is projected to raise from 70 years in 2010-2015 to 77 years in 2045-2050

By 2050, age 60 and above is expected to more than double from 901 million in 2015 to 2.1 billion

66% increase will be in Asia



Hence, there are motivations to develop smarter cities, especially in public safety, environment and utilities management, healthcare, and urban mobility

Smart Cities = real-time situation awareness for informed decision making (Big Data analytics)

Challenges of Big Data analytics

- Availability of data from different sources (Variety<sup>1</sup>)
- Quality and relevance of data (Veracity<sup>1</sup>)
- Ability to process a huge amount of data in a timely manner (Volume<sup>1</sup> and Velocity<sup>1</sup>)

# Smart Cities: Major trends in Urban Mobility

Moving towards Multimodal Optimisation



Connected vehicles



Self driving vehicles



Energy efficient vehicles



Telematics, Smart devices



V2V, V2I, V2X, I2I  
Communications



IoT Sensor Technologies



Big Data Analytics



Smart city initiatives



Mobility-as-a-Service



Data, data, everywhere...

How do we make sense of data generated in land transport?

GNSS Position Data

Telematics Data

Vehicle Status Data

Telco / Wi-fi Data

Video Data

Payment Transaction  
Data

Social Media Data

Big Data  
Analytics  
Platform

Real-Time Situational Awareness  
*"Know the current state."*

Real-Time Anomaly Detection  
*"Know immediately when something goes wrong."*

Real-Time Predictions  
*"Know what will happen in the near-future."*

After-the-Fact Performance Evaluations  
*"Know where are the areas of improvement."*

Operations Optimisation  
*"Know the optimal way of doing things."*



Actionable  
Insights



Static  
Reports

Interactive  
Dashboards

Self-Service Data  
Exploration

Alerts

## Big Data Analytics Platform

Hybrid In-Memory and On-Disk Storage and Processing

Data  
Analysis

Stream  
Processing,  
Complex Event  
Processing

Business Intelligence,  
Data Visualisation

Advanced Analytics

Data  
Integration

Messaging

ETL, ELT

Star Schema for BI



Analytical Base Table for AA



Data  
Acquisition



Data-in-Motion  
e.g., GPS, IoT



Data-at-Rest  
e.g., Fare card transaction data

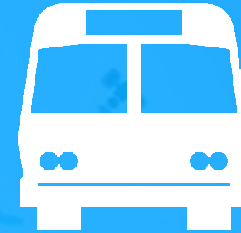
# Transport Analytics Platform

Real-Time and Batch-  
Oriented Analytics





Private Car



Bus

**How does Big Data Analytics benefit transport stakeholders?**



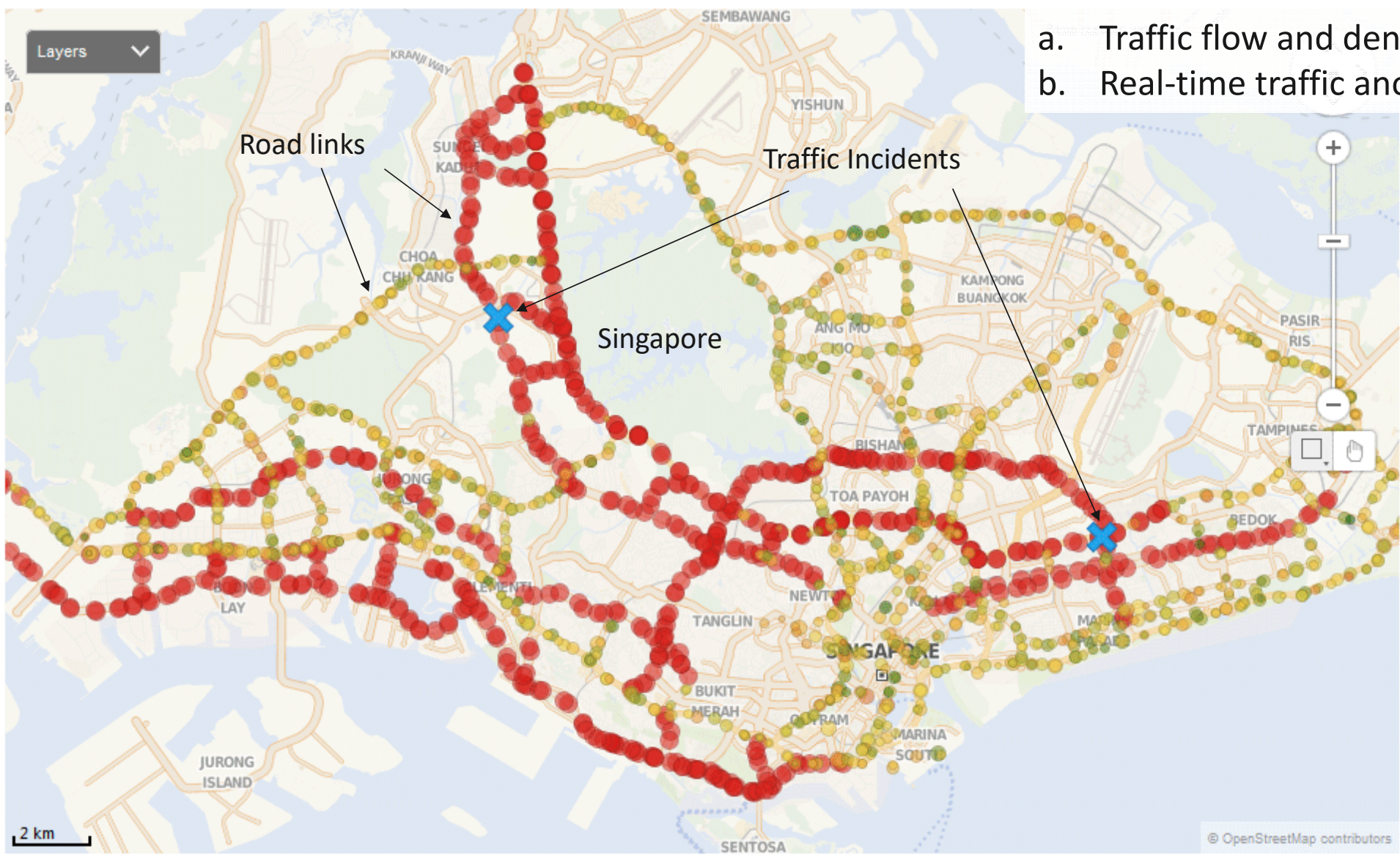
Rail



Taxi

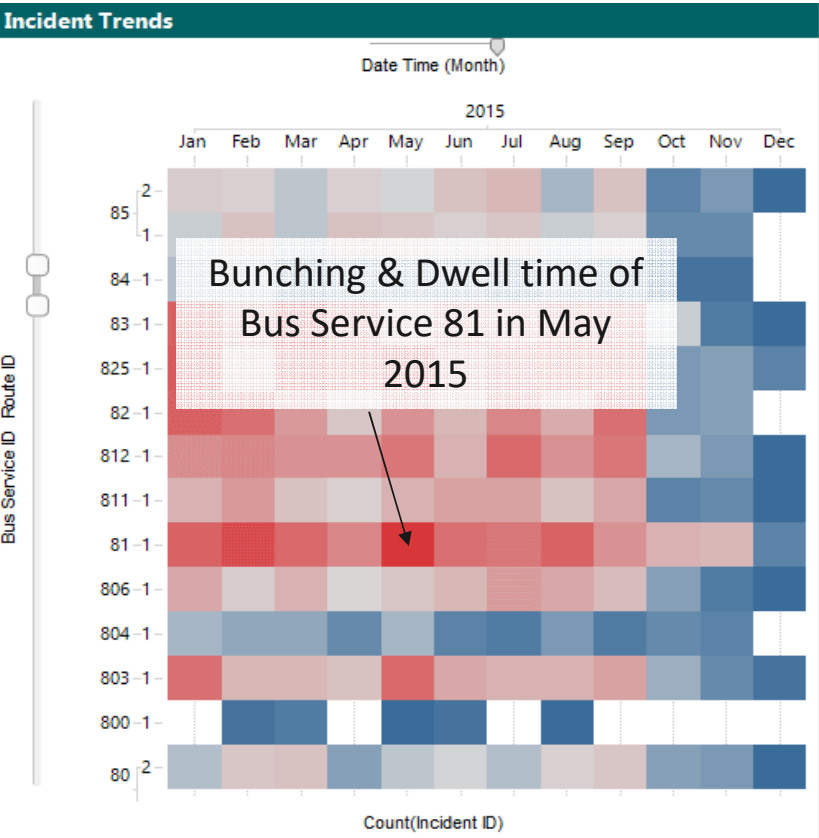


# Private Car: Statistical analysis on vehicle probe data



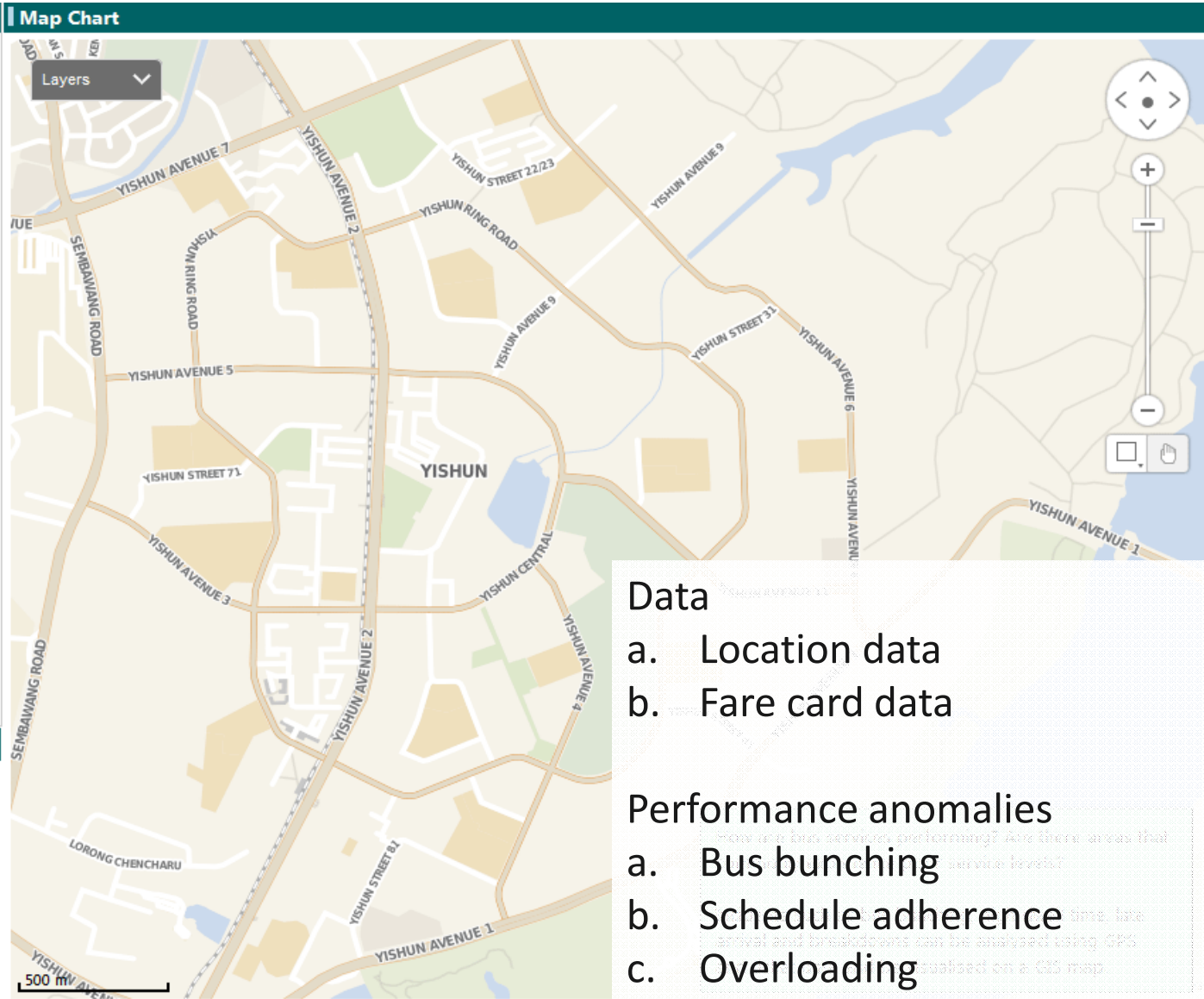
- a. Traffic flow and density
- b. Real-time traffic anomalies

# Bus: Track-and-trace of bus services in real-time.



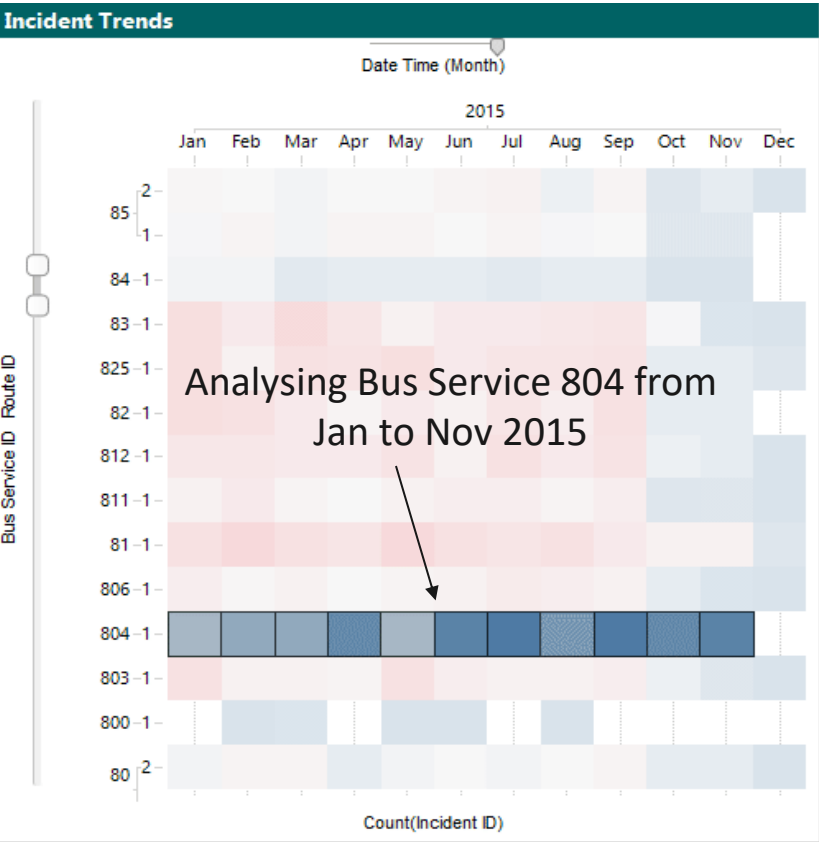
### Incident Details

| Incident ID | Date Time           | Incident Type | Bus Service ID | Route ID |
|-------------|---------------------|---------------|----------------|----------|
| 1           | 01/01/2015 06:01:22 | Dwell Time    | 138            | 1        |
| 2           | 01/01/2015 07:16:32 | Bunching      | 853            | 1        |
| 3           | 01/01/2015 07:28:30 | Bunching      | 4N             | 1        |
| 4           | 01/01/2015 07:46:51 | Bunching      | 284            | 1        |
| 5           | 01/01/2015 08:01:49 | Bunching      | 197            | 1        |
| 6           | 01/01/2015 08:04:08 | Bunching      | 185            | 2        |
| 7           | 01/01/2015 08:08:54 | Bunching      | NR2            | 1        |
| 8           | 01/01/2015 08:14:22 | Bunching      | 3              | 2        |



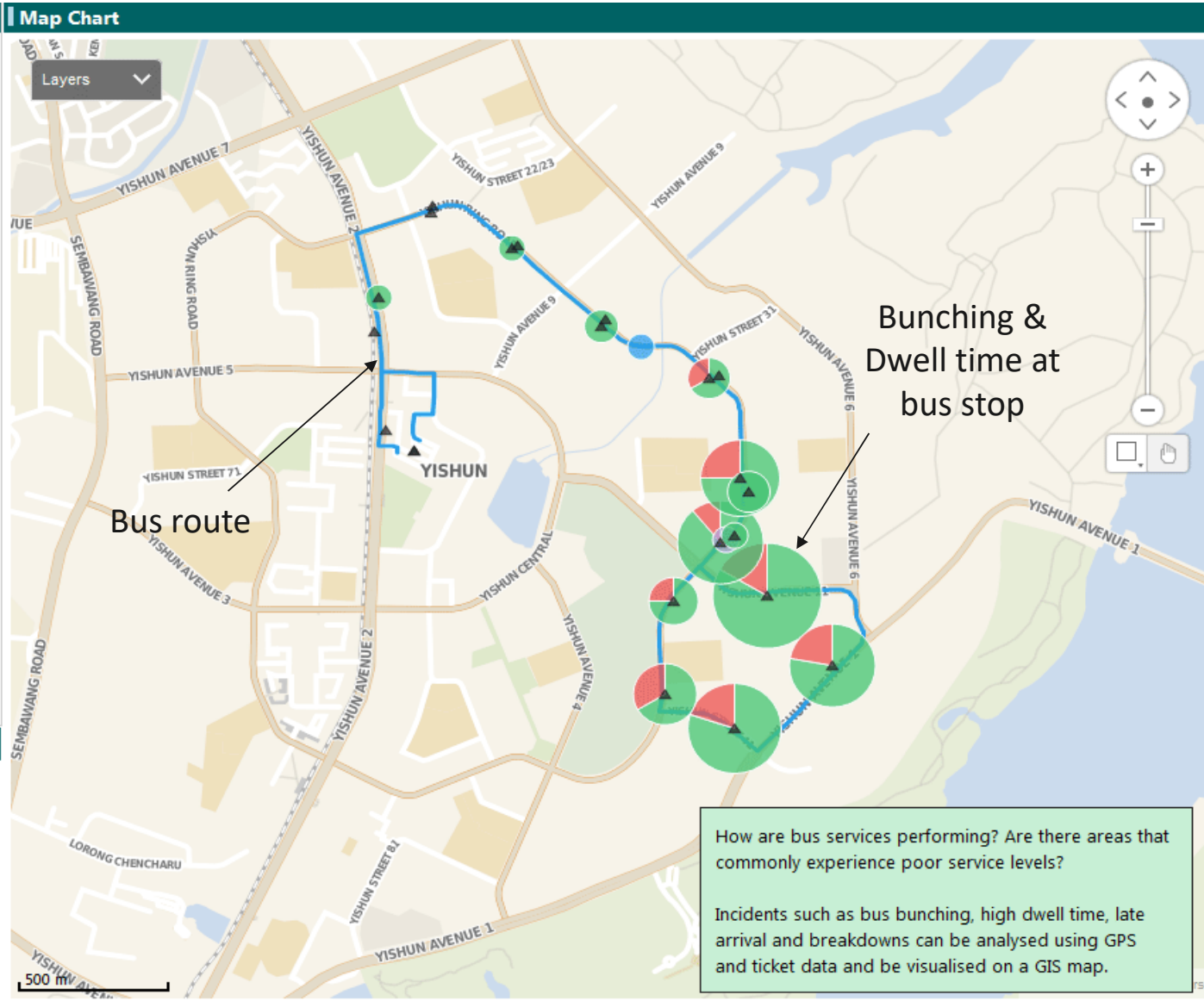
- Data
- a. Location data
  - b. Fare card data
- Performance anomalies
- a. Bus bunching
  - b. Schedule adherence
  - c. Overloading

# Bus: Track-and-trace of bus services in real-time.



### Incident Details

| Incident ID | Date Time           | Incident Type | Bus Service ID | Route ID |
|-------------|---------------------|---------------|----------------|----------|
| 213         | 01/01/2015 19:10:51 | Bunching      | 804            | 1        |
| 323         | 02/01/2015 09:21:20 | Bunching      | 804            | 1        |
| 1980        | 07/01/2015 19:27:14 | Dwell Time    | 804            | 1        |
| 3121        | 11/01/2015 18:20:29 | Bunching      | 804            | 1        |
| 4588        | 16/01/2015 18:28:25 | Bunching      | 804            | 1        |
| 5503        | 19/01/2015 19:27:36 | Bunching      | 804            | 1        |
| 6448        | 22/01/2015 21:42:36 | Dwell Time    | 804            | 1        |
| 6674        | 23/01/2015 19:06:50 | Bunching      | 804            | 1        |



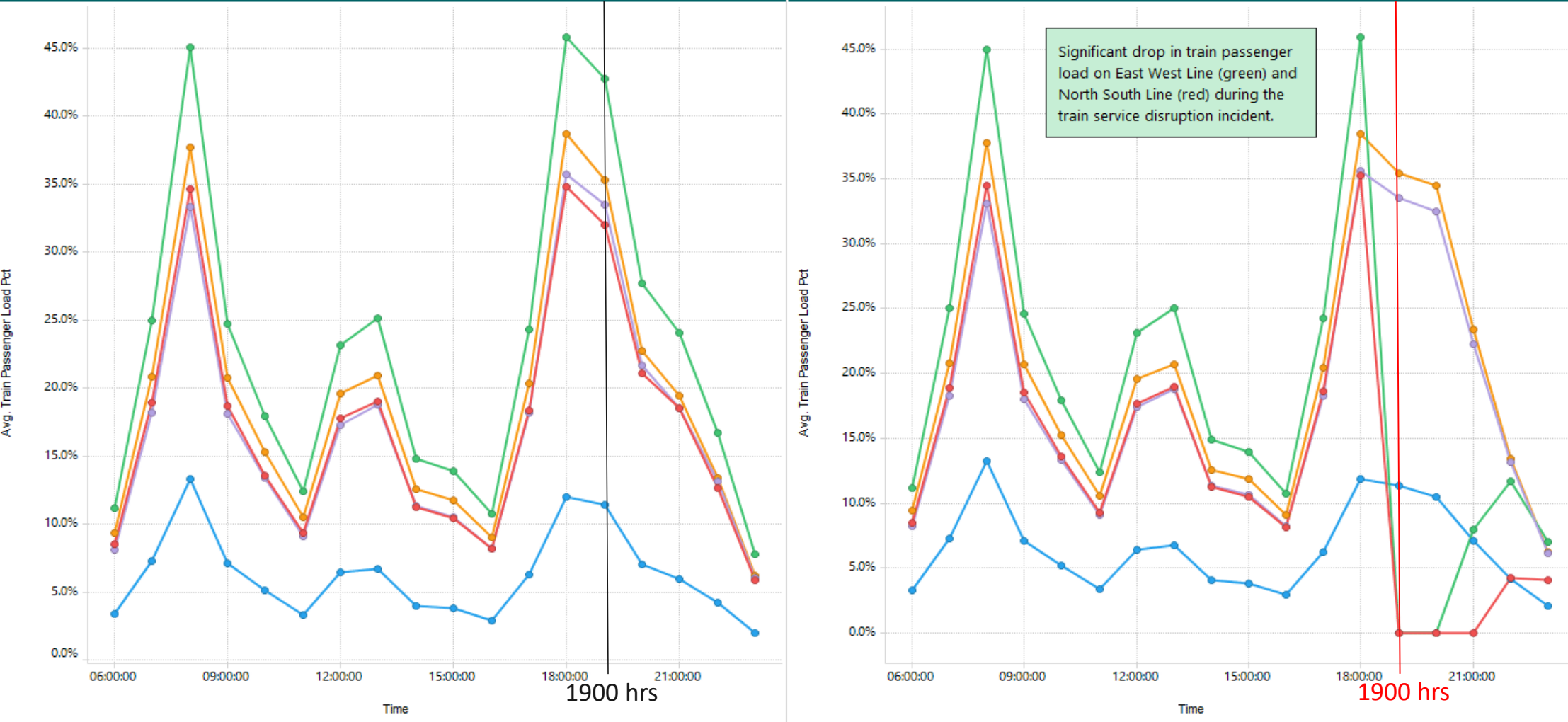


# Rail: Track-and-trace of MRT commuters' movement in real-time.



Typical Day: Avg. Train Passenger Load

Train Service Disruption Day: Avg. Train Passenger Load



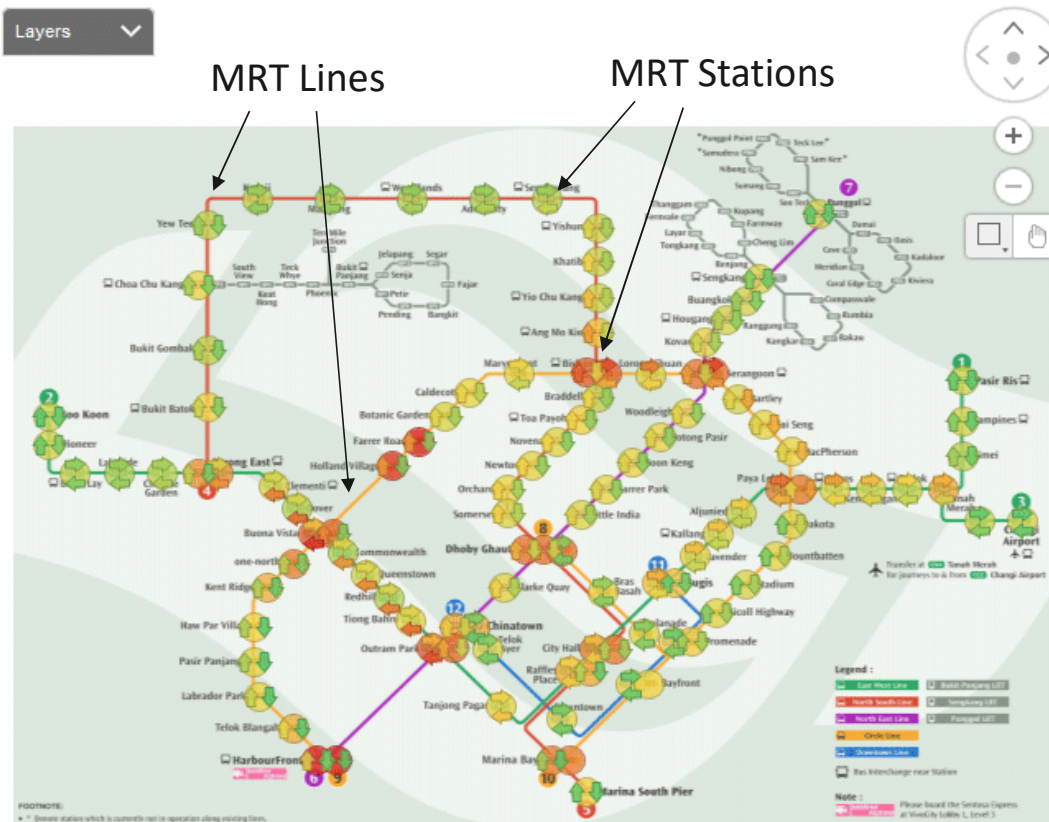
## Rail: Track-and-trace of MRT commuters' movement in real-time.

### Time of Day

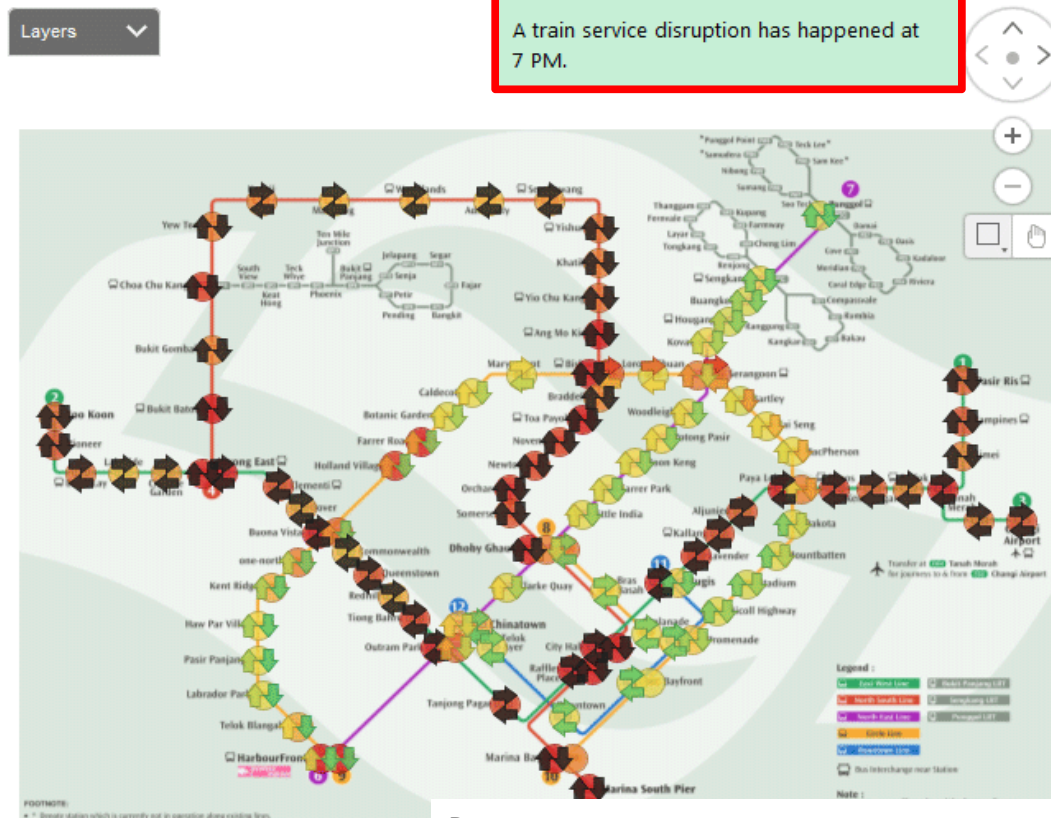
|          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |          |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 06:00:00 | 07:00:00 | 08:00:00 | 09:00:00 | 10:00:00 | 11:00:00 | 12:00:00 | 13:00:00 | 14:00:00 | 15:00:00 | 16:00:00 | 17:00:00 | 18:00:00 | 19:00:00 | 20:00:00 | 21:00:00 | 22:00:00 | 23:00:00 |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|

## Typical Day

## Train Service Disruption Day



Circles: Train platform crowd level.  
Arrows: Train passenger load.

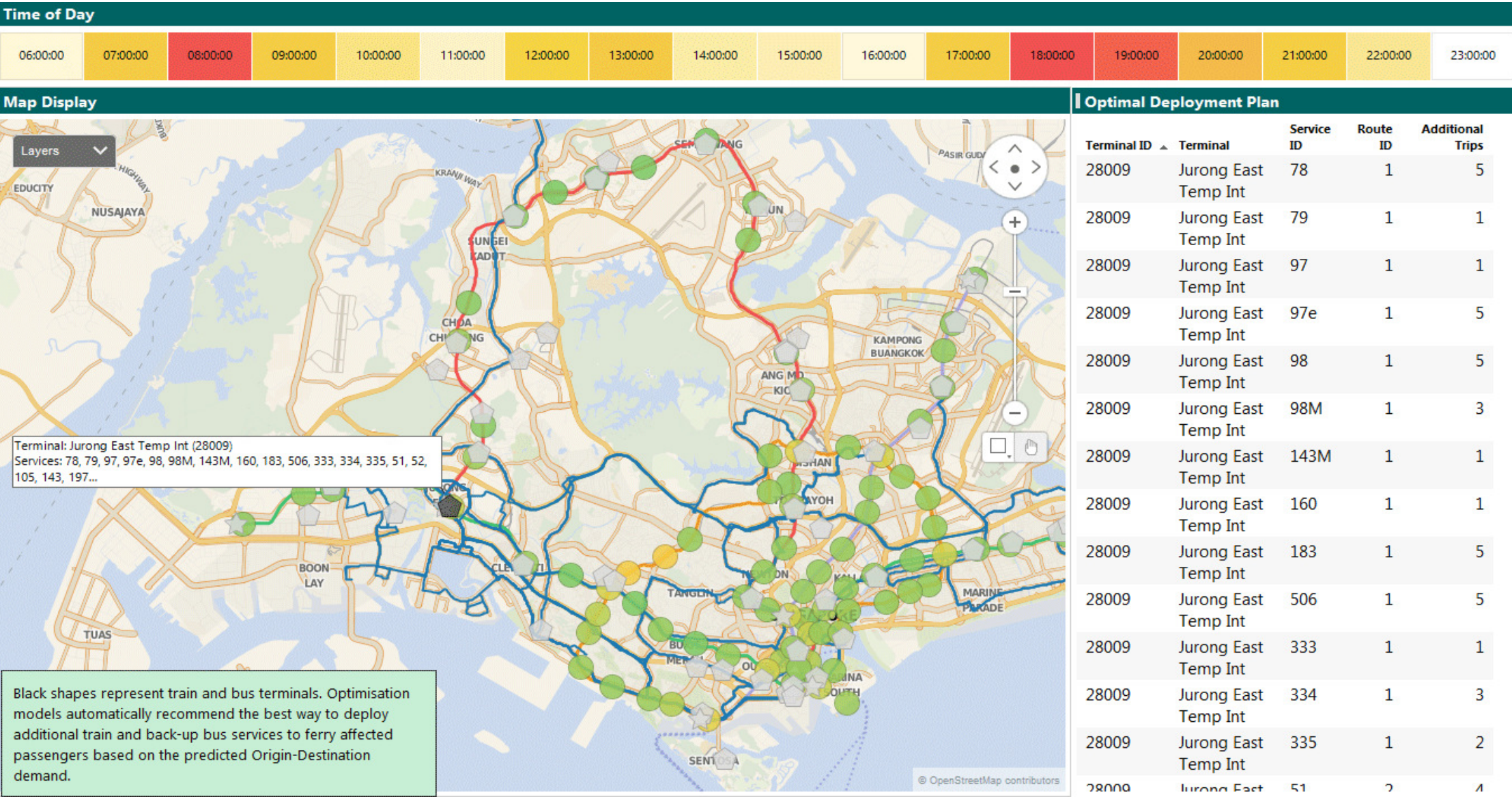


## Data

- Location data from telco and wi-fi
- Fare card data
- Video analytics

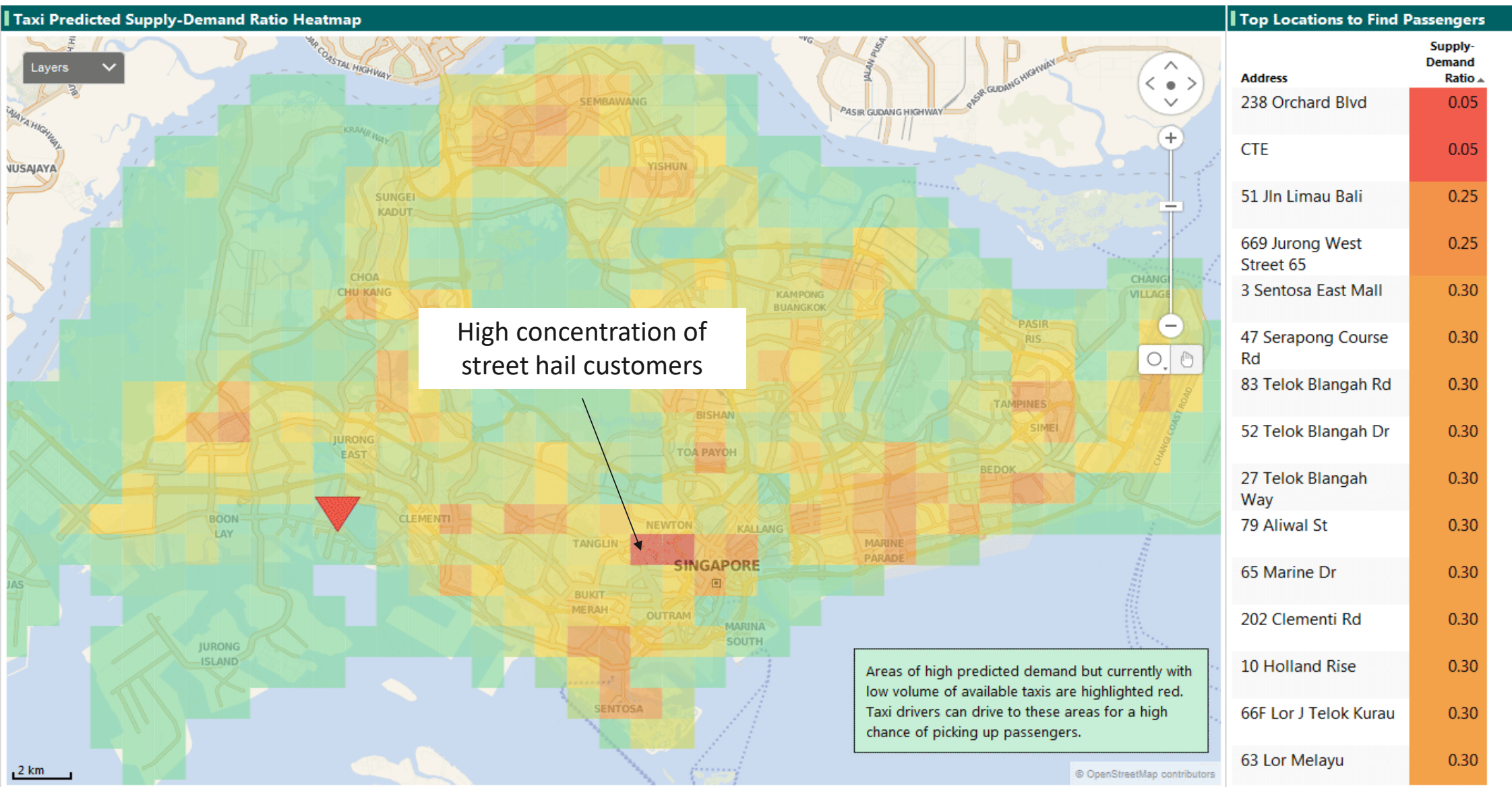


# Rail: Optimisation models to help affected commuters during an incident

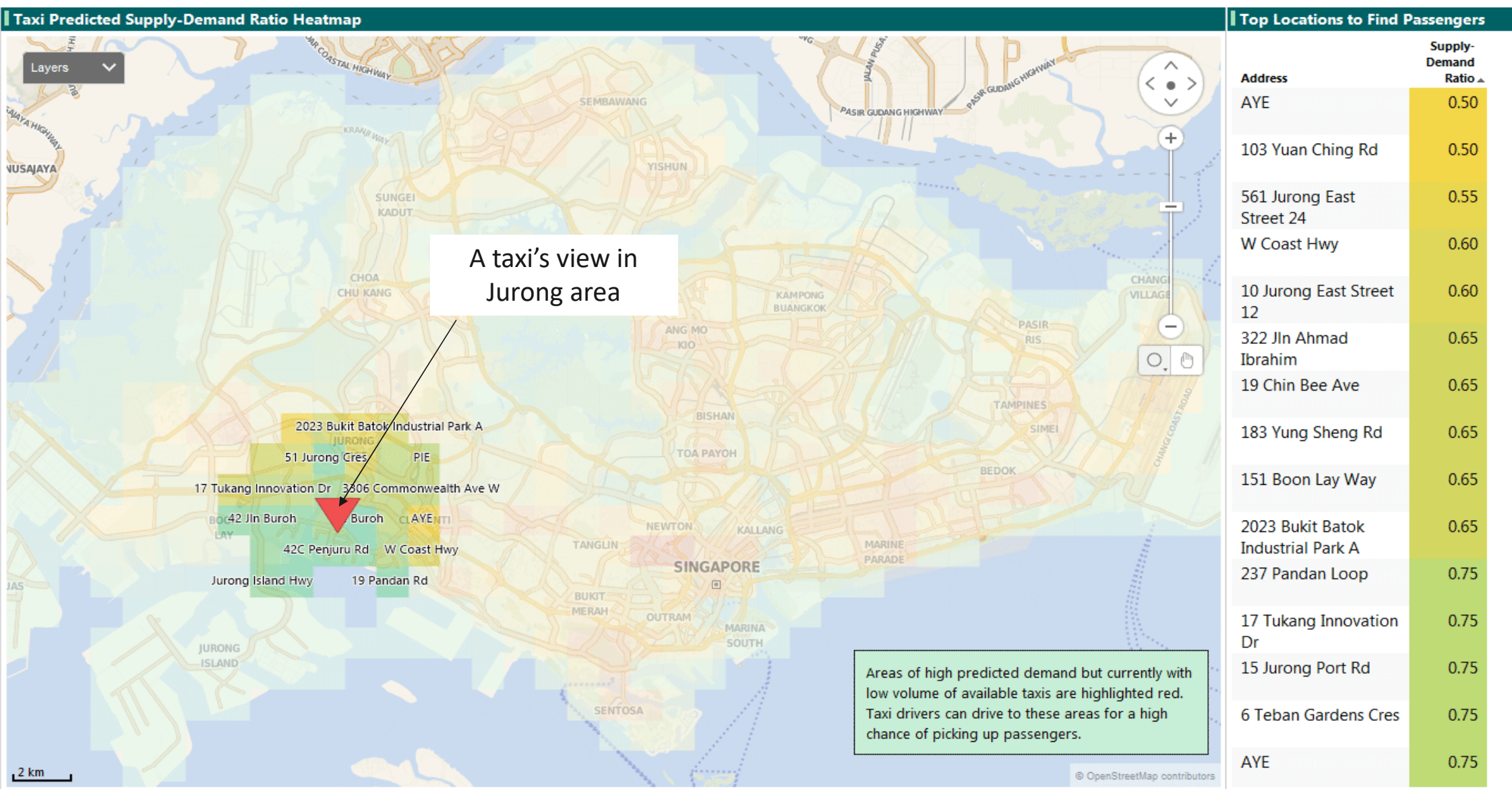




# Taxi: Predictive analytics to help taxi drivers with street hail customers



# Taxi: Predictive analytics to help taxi drivers with street hail customers



# Singapore ITS Vision

- *People and transport system...*
- *... more connected...*
- *... more interactive...*
- *... a well integrated and sustained transport system*



## Singapore's ITS Vision



Singapore's ITS vision is "Moving towards a **more connected and interactive** land transport community", a well integrated and sustainable transport system. A smart urban mobility of the future where **people and the transportation system** are seamlessly connected, interacting through innovation, state-of-the-art ITS technologies.

Source: Smart Mobility 2030

# Focal areas of Smart Mobility 2030



Source: Smart Mobility 2030

Confidential

Strategy

Implement Innovative and Sustainable Smart Mobility Solutions

Develop and Adopt ITS Standards

Establish Close Partnerships and Co-creation

Focal Point

Informative

Interactive

Assistive

Green Mobility

High Quality Transport Information to Meet Diverse Needs

Enhanced Traveler Experience with Smarter Interactivity

Towards a Safe and Secure Roadway Environment

Towards a Sustainable and Environmentally Friendly ITS

Intelligent Transport System





We leverage on the next generation technologies to empower individuals and enable communities and cities



Our Smart Cities Solutions



## Channel NewsAsia Singapore Business Tonight

9 Feb, 2015

SURF@NCS will function as a living lab for public agencies and commercial enterprises to create and test bed smart cities innovations.

PHOTOS VIDEOS



SINGAPORE: NCS' smart cities lab, SURF@NCS, which forms part of NCS' Solutions for Urbanised Future (SURF) initiative, was launched on Monday (Feb 9).

SURF@NCS will function as a living lab for public agencies and commercial enterprises to create and test bed smart cities innovations.

The lab will also create an ecosystem of like-minded partners for smart city development, starting with 15 global technology players, local startups and research institutes.



## NCS launches SURF@NCS to develop smart city solutions

Zafar Anjum | Feb. 9, 2015



Responding to the national call to build Singapore into the world's first Smart Nation Singtel-subsiidiary NCS today launched SURF@NCS as part of its Solutions for Urbanised Future initiative.



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