Fujitsu-SMU Urban Computing & Engineering Corp. Lab

GRAND-VISION: An Intelligent System for Optimized Deployment Scheduling of Law Enforcement Agents

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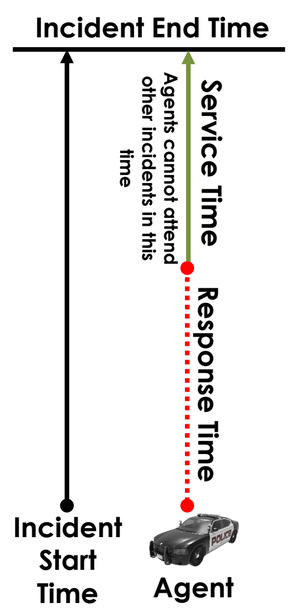
Data-Driven Optimized Deployment Scheduling

With limited manpower, law enforcement agencies are turning to AI to predict and prevent incidents through smart patrol strategies. Working with local law enforcement, we have developed GRAND-VISION (Ground Response Allocation and Deployment: Visualization, Simulation, and Optimization), a data-driven daily patrol planning system. The system optimizes response times through a daily algorithm that accommodates break times and manual input to deploy law enforcement agents to predefined patrol regions in a real-world scenario informed by machine learning.

The GV system employs a 4-step deployment process:

Agents patrol their assigned geographic regions. When an incident occurs, an agent is assigned to attend with a travel time that can meet the QoS requirements.



Incident generator

The incident generator produces training and testing incident sets for the selected date.

Optimizer

Incident sets are fed into an MIP to find a robust allocation plan giving the number of cars per region in each time period. The aim is to **minimize the number of failed incidents**.

Scheduler

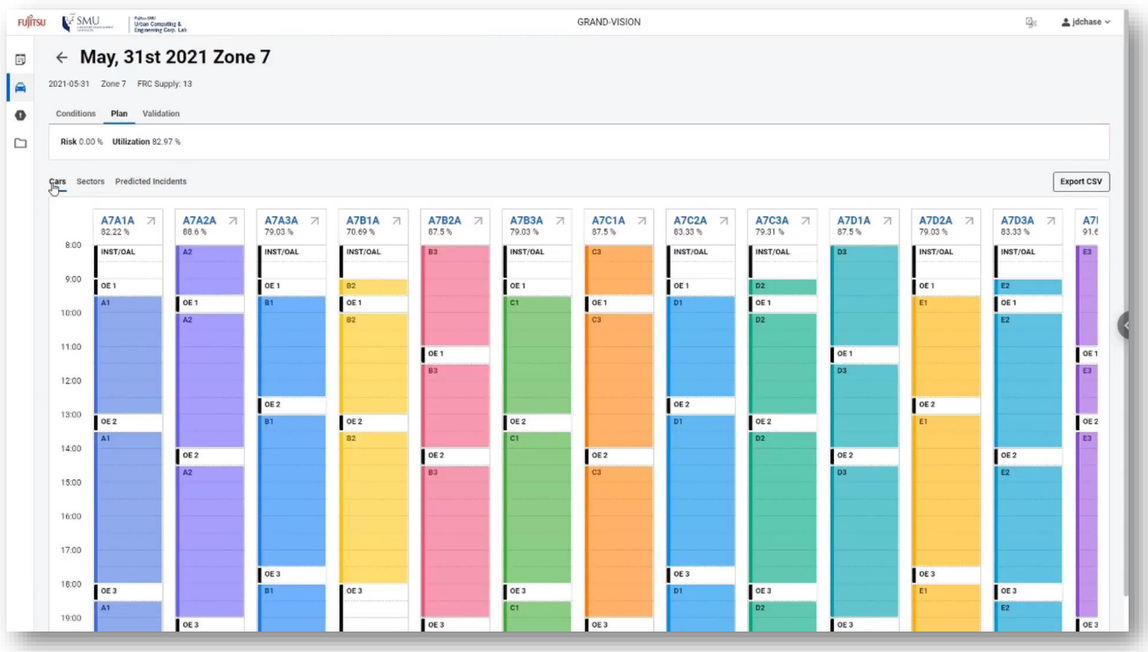
Takes the allocation plan and assigns specific patrol cars to the regions they are required in so that the amount time spent travelling required by the cars is minimized.

Simulator

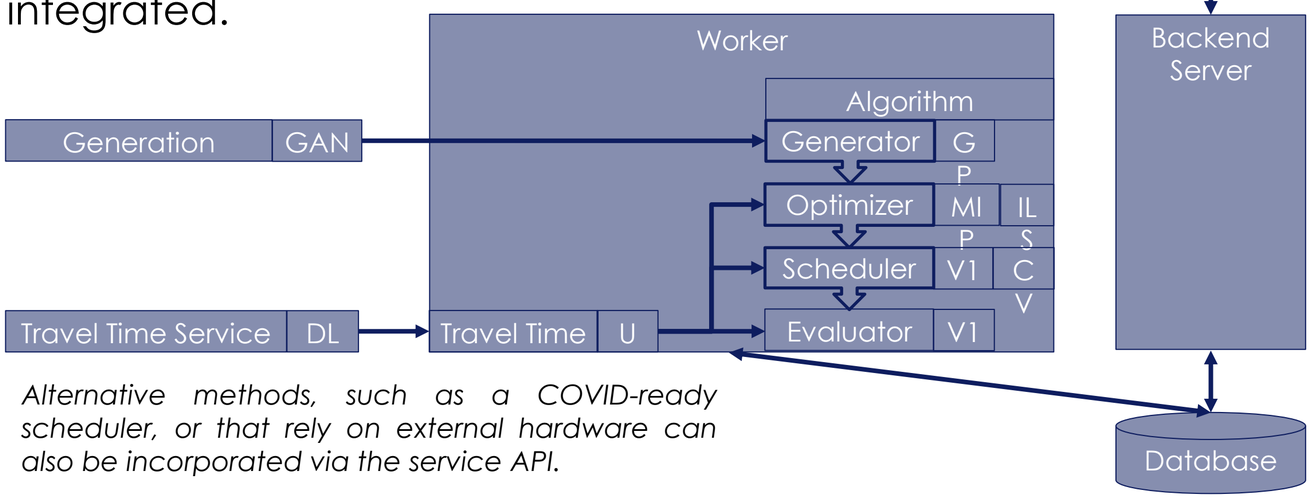
A simulation tests the allocation plan on the testing incident sets to determine expected performance when the plan is put into practice.

GRAND-VISION SYSTEM

The system supports two users – Commanders, who have a stream-lined interface for daily deployment, and Analysts, who are power users and can experiment with new methods and update the prediction models.



The system is deployed using a Python backend and a web-based frontend. A service-based architecture allows new implementations to be seamlessly integrated.

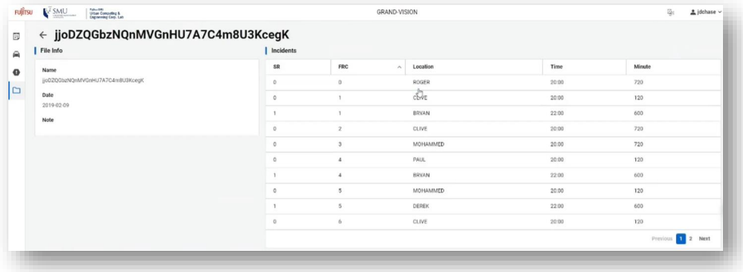


Alternative methods, such as a COVID-ready scheduler, or that rely on external hardware can also be incorporated via the service API.

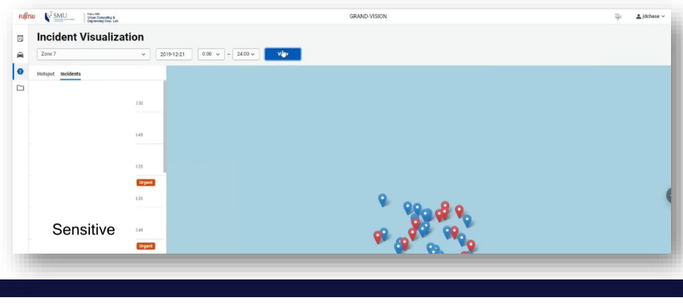
The deployment plan output is the centrepiece of the system. This screen provides commanders the information needed to use the plan. Individual agent schedules can be exported for distribution to agents. Changes of location are clearly indicated by colour and breaks are marked by white blocks.

Other System Features

Data Upload: Historical incident data and actual agent deployment plans can be uploaded for updating the incident prediction model and facilitating performance validation.



Performance Validation: After a plan is put into practice, the incident data from that shift and the actual deployment can be used to simulate performance against the system prediction and plan.



Incident Visualization: Uploaded real incident data can be overlaid on a map from OpenStreetMap, using either GPS markers or patrol region heatmaps.

Development and Trial Experience

COVID-19: The pandemic was disruptive to partner meetings and trial execution, but also provided new research opportunities, such as adapting the scheduler to limit cross contact.

Operational considerations: Unlike abstract research, applying a real world solution meant that methods always needed to be assessed for operational viability, providing improvements in a way that could be 'sold' to the staff that had to implement them.

Limitations of automated planning: Working with the agency, we got to explore where experience and expert knowledge must be incorporated into the system, recognizing the limitations of data-based planning.

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