2023 NOCoE Transportation Technology Tournament

Special Event Transportation Planning: 2024 NFL Draft

"The Wolverines"

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Contents

List of Figures

List of Tables

List of Acronyms

NFL National Football League

ITS Intelligent Transportation System

JPO Joint Program Office

PCB Professional Capacity Building

UM University of Michigan

MDOT Michigan Department of Transportation

CoD City of Detroit

USDOT U.S. Department of Transportation

Con-Ops Concept of Operations

1 Overview

This document is written for the 2023 Transportation Technology Tournament hosted by the National Operations Center of Excellence and the U.S. DOT ITS JPO PCB program. This report presents the operational concepts of a proposed solution that addresses special event traffic and transportation management planning for the 2024 National Football League (NFL) Draft in the city of Detroit. The University of Michigan (UM) team "The Wolverines" has synthesized a solution package to tackle the transportation challenges of a high surge of demand anticipated and a change of paradigm in people's transport needs during that weekend.

1.1 Problem statement

Special event traffic management is a vital part of urban transportation management. Several U.S. cities that have worked on special event transportation management include but are not limited to, Anaheim, CA [1], Atlanta, GA [2], Fort Myers, FL [3], and New York, NY [4] – these cities hosted a variety of events, e.g., sports events or exhibitions.

The Michigan Department of Transportation (MDOT) and the City of Detroit (CoD) envision having such a similar issue from the 2024 NFL Draft in Detroit. The city expects the event to bring nationwide attention to Detroit and believes the success of this event to be vital in reviving the city's image. The team collaborates with MDOT and CoD to incorporate management and infrastructure-based technology solutions into the current infrastructure to enhance network efficiency and safety. The team considers several potential solutions, which span from making traffic demand predictions to introducing new transportation infrastructure and subsequential policies. The investigation projects are to be further extended to lay a general framework for future traffic management plans in the city.

The team presents the package as follows. The remainder of Section 1 outlines details of the problem such as the study area and examines the city's current preparation. In Section 2, we first introduce a demand forecasting tool that would inform the solution proposals for practicability, and then propose the solution strategies for the problem. Specifically, we prepare the following three pillars of solution strategies:

- *Infrastructure improvement*: repurpose the existing road infrastructures to promote participants' safety and comfort on the days of the event;
- *Traffic management*: suggest policy adjustments in mobility operations during the event to accommodate surged demands with different characteristics;
- *Information provision*: develop interfaces to notify the eventgoers of real-time transportation availability conditions.

Then, Section 3 illustrates the concept of operations (Con-Ops) analysis, cost breakdown, and expected timeline for the proposals. Section 4 further extends the study by presenting the anticipated outcome of the solution strategies, and Section 5 summarizes the solutions pacakage.

1.2 Study area and Current situation

1.2.1 Visitor demand

As a hub of major operations of the state, Detroit is the largest city in the state of Michigan, hosting both intra- and interstate ground transportation. With a population exceeding 60K, the city's daily traffic volume is increasing. MDOT reports a 7.3% increase in yearly traffic volume since COVID-19 in 2020 [5].

The city is connected to other major U.S. cities such as Chicago, IL, and Cleveland, OH, on the western and southern sides, respectively, and it shares a border with Ontario, Canada on the east side. Major freeways such as I-75 and I-94 as well as the Ambassador Bridge and the Detroit Windsor Tunnel connecting the U.S.-Canadian border bring a significant influx of daily traffic to the city.

During the 2024 NFL draft, the city expects an increase in both in-state and out-of-state visitors to the city. This is a notable difference from the existing events in the city, e.g., sports events, as those events attract more in-state visitors than out-of-state ones. Also, the 2024 NFL draft is a free, multi-day event, which attracts more visitors and complicates the logistics even further. We can expect more unpredictable demand from both people living in the vicinity trying to have a short experience of the event to people traveling multiple hours for the event and staying in the city during the entire event.

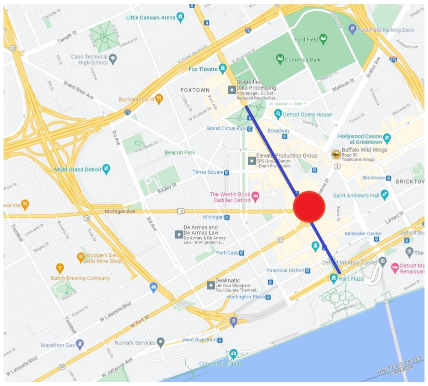

Figure 1: Event venue at downtown Detroit.

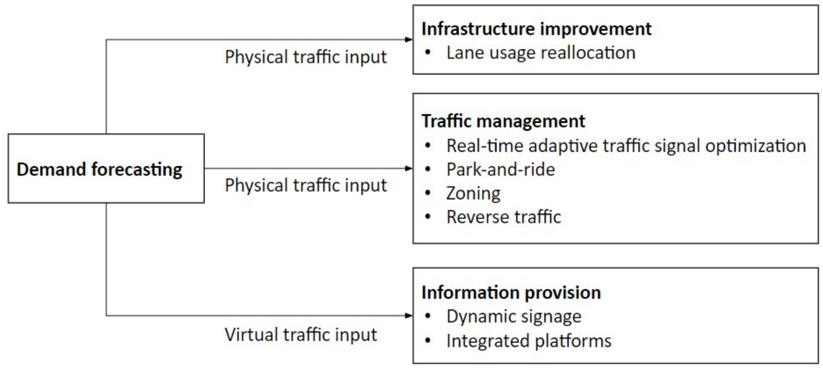

Figure 2: Solutions framework.

1.2.2 Event venue

The event is scheduled to occur in the downtown area of Detroit. The main stage will be set up at Campus Martius Park, which is marked by a red circle in Figure 1. As shown, the park is located at the heart of the city, and Woodward Avenue, a major corridor indicated by a blue line, will be entirely blocked for pedestrians and local events. Also, several road and intersection closures are expected to accommodate stage installations, event booths, etc.

Another consideration is the timeline of the closure, which would be longer than the duration of the event. For instance, CoD expects the closure of some of the major corridors to happen several weeks preceding and after the event as stage installation requires an extended timeline of logistics and workforce. This is an unusual consideration in Detroit because other large-scale events in the city typically require road closure only during the event.

1.2.3 Existing planning

It should be noted that NFL has priority in planning the logistics of the event, e.g., event scheduling, identifying event zones, and infrastructure planning, and CoD has organized several committees to coordinate with the league. CoD expects to face numerous challenges in parking, lodging, beautification (gardening, resurfacing, etc.), and especially, safety. The Detroit police department currently estimates 350,000 - 500,000 visitors during the event weekend.

However, the city has not yet prepared detailed planning for the event, and one reason is the delay in coordination with NFL. The 2023 NFL draft was held in Kansas City, MO, less than a month ago (April 27 - 29), and both CoD and NFL are in the process of debriefing that event for better operations in 2024. This provides a unique opportunity for our team to engage in the planning of the event by assisting CoD, albeit working within constraints by both CoD and NFL.

Overall, the city anticipates that the event will attract a much more diverse group of visitors compared with other events previously hosted by the city and a much larger logistics challenge than a regular sports event. The city should prepare multidimensional strategies that would address traffic needs while not disturbing NFL's master plan. In that process, the city notes several key features that would impact attendance such as weather and community engagement.

2 Solution Statement

For the main solution set, we first suggest a traffic demand forecasting methodology that would accurately predict traffic demand scenarios. Then we prepare three main streams of solutions to accommodate the predicted traffic demands for the 2024 NFL draft transportation planning. Figure 2 outlines the framework of the solution proposal.

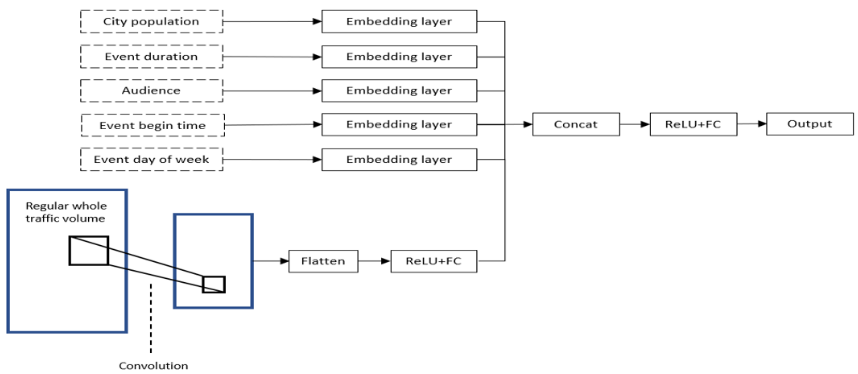

Figure 3: Structure of the prediction model.

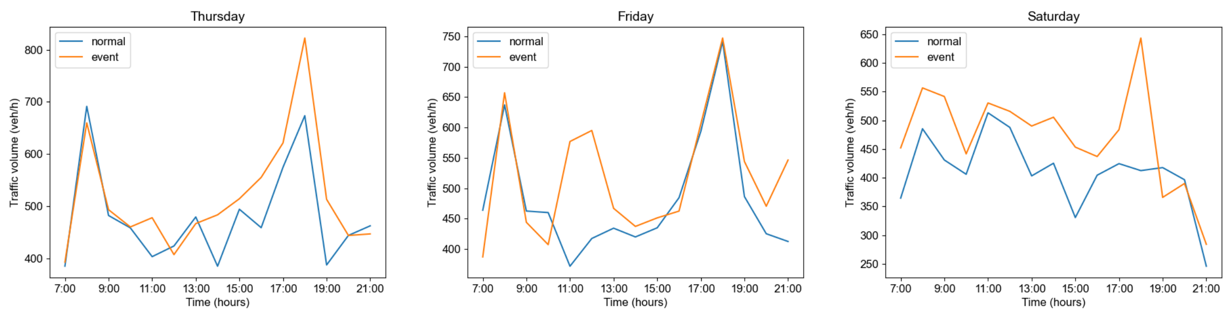

Figure 4: Traffic volume for the 2023 NFL Draft (Thursday - Saturday).

2.1 Demand forecasting

Predicting the scale of the challenge is critical in preparing any special events transportation planning. Accurate predictions would allow physical traffic inputs for infrastructure improvement and traffic policy management solutions as well as virtual traffic inputs for information provision solutions.

2.1.1 Model introduction

Any solutions to facilitate traffic during the NFL draft in CoD will depend on the volume of demand to participate in the event. As such, as a first step, we develop a demand forecasting model to predict the traffic volumes in the highway system surrounding the 2024 NFL draft venue in Detroit during the event. More specifically, we will use data from previous large-scale professional games from the National Basketball Association (NBA), the National Hockey League (NHL), and NFL to train a *neural network model*, whose architecture is described in Figure 3.

The set of inputs to this model includes the number of audiences who attend in person, the event day of the week, the event duration, the event start time, and the population of the city. Furthermore, observing the history of such sports games, it becomes clear that the stadiums are generally surrounded by highways and freeways, and the traffic patterns during the course of these events follow the same general trends as on regular days, but with a higher volume. An example of such a trend is shown in Figure 4 for the 2023 NFL draft in Kansas City. Therefore, another input to the model consists of traffic volumes on the same day and time of the games, but from a previous year where no games were being played. The output of the demand forecast model is the traffic volume during the game, which we would like to predict.

To train our neural network model, we use data from 50 professional games played in 2022 by the Kansas City Chiefs of the NFL, the Dallas Mavericks of the NBA, and the Los Angeles Kings of the NHL. The geo-locations of the three stadiums are depicted in shaded regions of Figure 5. We utilize data collected from detectors installed on freeways and highways around the stadiums to obtain traffic flow volumes. Volumes in 2021, along with other input features specified previously, will provide the input to the model, and traffic volumes in 2022 during the game days will serve as model outputs.

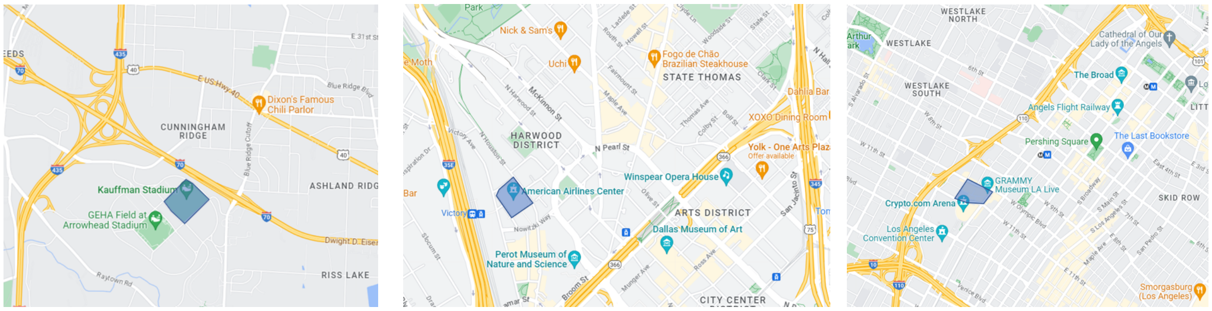

Figure 5: Stadium locations for Kansas City Chiefs (left), Dallas Mavericks (center), and Lost Angeles Kings (right).

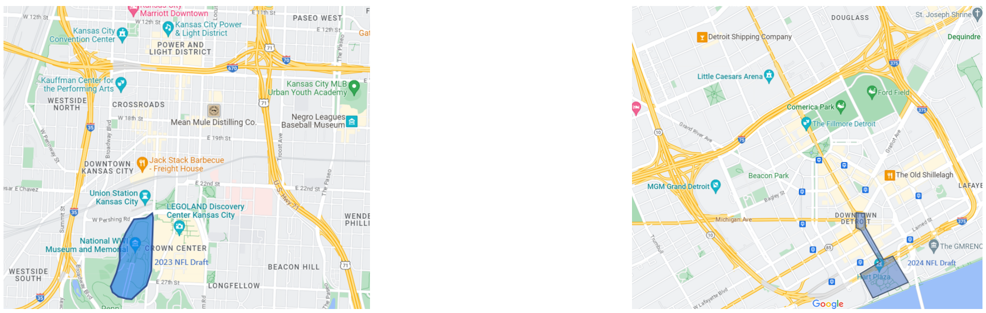

Figure 6: Comparison of the 2023 NFL Draft (Kansas City; left) and 2024 NFL Draft (Detroit; right) locations.

After training the model, we validate it using the data from the 2023 NFL draft in Kansas City. We choose to validate our model using the 2023 NFL draft in Kansas City because the structure of the highway network around the venue in Kansas City closely resembles that of the 2024 NFL draft venue in Detroit, as depicted in shaded regions of Figure 6. The left side of Figure 6 shows the 2023 draft event location in Kansas City, indicating that the event was primarily served by three freeways: I-670 running east-west, I-35 running north-south, and US-71. The right side of Figure 6 shows the main stage location for the 2024 NFL draft in Detroit. There are also three freeways in the vicinity of the venue (I-75, MI-10, and I-375), each of them having six-lane dual carriageways.

More precisely, we feed the input data for the 2023 draft held in Kansas City to the model and compare the model output to the real traffic data collected in 2023. Results indicate an average root mean square error (RMSE) of 56.67 for the average hourly traffic flow during the three-day period of the Kansas NFL draft in 2023. Compared to the average traffic flow of 454 vehicles per hour, the prediction error is 12.5 %. These results indicate that the model can reasonably predict traffic flow near special events.

2.1.2 Demand forecasting results

The next step is to predict the traffic scenario for the 2024 draft event using the abovementioned prediction model. We use the average traffic flow from April 2023 of Detorit's three freeways, along with other features specified in the previous section, to form the input vector to our neural network model. Figure 7 shows the 2023 traffic volumes averaged over the three highways in Detroit, along with the predicted values for 2024 on I-375, as an example. In the figure, the blue lines depict the predicted daily traffic volume on a normal day, i.e., where there is no special event occurring, and the orange lines describe the predicted daily traffic volume during the 2024 draft event days.

The predictions indicate that the traffic volumes on these three roads are expected to increase by an average of 25.63% during these three days. Specifically, there is a noticeable increase in average hourly traffic flow on the first and last days of the draft. One potential explanation is that on the first day of the NFL draft, round 1 selections take place, which generates significant interest and attendance. On Saturday, which is the last day of the event, all remaining visitors would leave the city. Combined with the local visitors enjoying their weekends, it results in an increased traffic flow. Therefore, it is crucial to guide the traffic flow appropriately considering these changes. We will discuss our solutions for managing this high volume of traffic flow in subsequent sections.

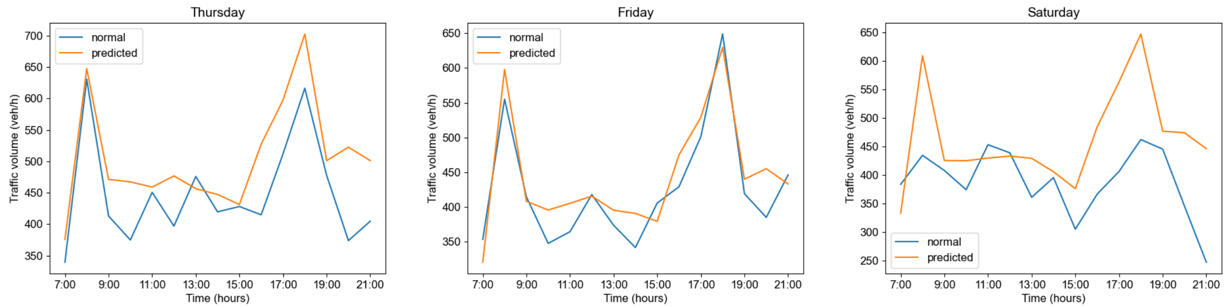

Figure 7: Predicted traffic volume for the 2024 NFL Draft (Thursday - Saturday).

Figure 8: Jefferson Avenue temporary redesign.

2.2 Infrastructure improvement

Infrastructure takes a crucial part in mobility operations. In general, traffic flow, information communication, and emergency handling capacities will be greatly improved through the upgrading of infrastructure. Although major projects on existing infrastructure are limited due to the limitation of time, we advise one pilot program that would enhance the city's mobility operations, guarantee the smooth holding of the NFL draft, and serve as a groundwork for long-term city planning.

2.2.1 Lane usage reallocation

We propose *lanes usage reallocation* on certain streets as a first-step infrastructure improvement for the 2024 NFL draft. The reallocation of traffic lanes to bus lanes, bicycle lanes, and protected pedestrian spaces can improve the safety of the event-goers and promote their engagements during the event. One of the major streets that we propose should undergo this short-term transformation is Jefferson Avenue, an 8-lane boulevard street that runs parallel to the Detroit River in close proximity. Our proposal is to convert the eastbound 4-lane side of the boulevard into bus shuttle lanes, bike lanes, and an expanded pedestrian space with many amenities, as shown in Figure 8. These amenities include food stands, fun interactive games, and other activities that will increase the engagement of the eventgoers throughout the NFL draft weekend. These activities will be placed adjacent to the bus station to increase people's participation, and they will improve the engagement of the fans and stimulate more economic activities. The bus stations will host high-frequency shuttles and buses that connect eventgoers to larger parking spaces that are farther away from the main event, thereby reducing car traffic in the area.

We select to convert the eastbound (instead of westbound) for many reasons. The eastbound side of the boulevard is converted to have more pedestrian space closer to the Riverwalk, increasing people's access to the riverfront and rendering previously neglected spaces more viable. Also, as many streets intersect Jefferson Avenue from the North end at Jefferson Avenue, it is more advantageous to retain vehicular traffic while not extending to the other side with pedestrian traffic, creating fewer conflict points.

All of these changes are temporary for the purposes of the NFL draft; that is, these will be clearly and abundantly indicated by temporary lane markers, cones, and signage for the event. Nevertheless, it can be converted into a more permanent installment, including dedicated bus lanes that could expand to streetcar lines or light rails. Furthermore, dedicated bike lanes and walkways with protection that are adjacent to the bus and rail system would encourage pedestrian and cyclist demand while improving safety for these groups of more vulnerable road users.

It should be noted that the boulevard conversion proposal is motivated by the Queen's Quay Revitalization project in Toronto, Canada in 2015. This project reports to benefit the city greatly, increasing the number of pedestrians and cyclists on the street and along the lakefront. As such, we suggest there is no better time in Detroit to test a similar groundwork in a temporary manner than for the NFL draft.

As an extension, this solution can be also assisted by intelligence technology. For instance, data-sharing technology between buses and trains can help maintain consistent headway between them. Incorporating detection in the traffic lights to give priority to alternative modes can be prioritized. In this case, when bikers or pedestrians are detected, data will be sent to the traffic light which will then dedicate a longer green time to prioritize transit efficiency and pedestrian safety.

2.3 Traffic management

The NFL draft is a three-day event, with its impact expected to last for multiple weeks in the area. Temporary measures are often less costly than permanent changes, so they may be claimed to be more practical and applicable. Therefore, we include traffic management policy planning as another core part of the solution.

2.3.1 Real-time adaptive traffic signal optimization

The first proposal is a *real-time adaptive traffic light control system* (Figure 9), which can be designed to optimize traffic flow, increase throughput, and expand the adaptability of the newly designed system. This is critically advantageous when the event is over and the eventgoers all intend to leave at the same time.

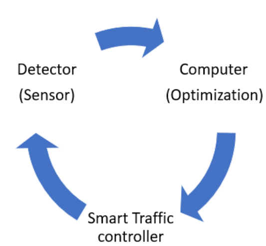

Figure 9: Real-time traffic light control system.

The system consists of three main components. The first component consists of traffic flow detectors, which could span induction loop detectors, cameras, laser radar, etc. Although the induction loop detector is the most widely used type of detector and has the lowest application cost, cameras can provide a higher detection range, thereby providing a more precise state of the system that can be utilized in the third component. The second component is the communication infrastructure, which allows data to be transmitted from sensors to traffic control centers and back to traffic signal systems, or directly from sensors to the edge devices installed in the road-side units at the signalized intersections. Finally, the third component comprises an optimization module, either in the traffic center or the edge device, that utilizes real-time data to adaptively optimize the traffic signal phasing and timing. This solution is enabled by recent technological breakthroughs in video processing and decentralized optimization that respectively allow for informing optimization models with high-quality data and obtaining optimized traffic signal timing and phasing in real-time.

2.3.2 Park-and-Ride system

Another major challenge of the event is the high traffic demand of fans coming from nearby regions and even across the states. The downtown area is out of capacity for the large volume of audience. One solution to this is a *park-and-ride policy* to reduce the demand in the downtown area, which would control the number of cars in the city and provide alternative transit options to the overflow of customers.

We provide a proposal for the park-and-ride system in this section. Figure 10 depicts the positions of the parking lots for the system on the outer circle along Grand Boulevard, denoted in yellow circles. These locations are 3 miles from the downtown area, requiring a 10-minute drive or a 1-hour walk. The lots are

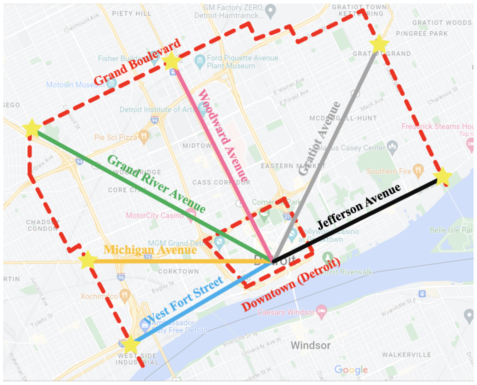

Figure 10: The parking slot assigned for the Park and Ride system.

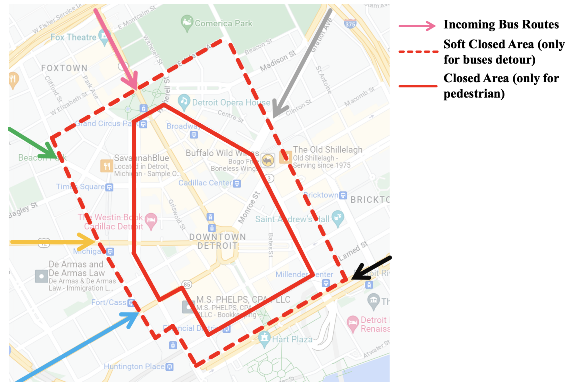

Figure 11: Zoning example.

directly connected to the downtown area by arterial routes, such as Woodward Avenue, Grand River Avenue, Michigan Avenue, etc., and public transportation substitutes for car driving. The positions are chosen to disperse the coming traffic to a wider range area, consequently relieving the pressure on the road systems.

For these arterial routes, existing bus lines and transit systems can be extended to build up the public transportation system. For instance, there are Qline – a local streetcar system – and bus routes such as 4-Woodward, 461, and 462 along Woodward Avenue, and similar options are available for all six avenues connected to Campus Martius Park. During the event, the frequency of the current bus lines should be increased, or high-frequency shuttles between the remote parking lots and the event site can be introduced to meet the needs of transit between parking lots and the event spot.

2.3.3 Zoning

We recognize that several roads and intersections would face temporary closure during the event, and consequently, many mobility operations would be interrupted. As such, we may specify *zones to allow/disallow certain transportation modes* to arrange smoother mobility operations and reduce downtown traffic. The core event area, shown by the inner red circle in Figure 11, is assigned to be a pedestrian-only zone to guarantee the safety of the people, and allow full capacity to be used for the event. The outer dotted line of the figure indicates the soft-closed zone, where only public transportation, e.g., buses or trams, are allowed to operate, and the exterior of that zone provides a dynamic interface of all means of transportation, with a circumference large enough to accommodate the coming traffic and prevent a possible traffic jam. Furthermore, if some allowance for private vehicles to enter such soft-closed zones is needed, a pricing system could be applied to such areas for travel flexibility.

2.3.4 Reverse traffic

We suggest another policy to allow *reverse traffic*, i.e., convert the two-way traffic into a one-way one, which is a protocol often used for natural disaster evacuation planning. To help us with our solution, we have investigated case studies of other cities that have undergone similar one-way street conversions for their events. For example, in Ann Arbor, MI, which is the home of the University of Michigan, interstate I-94 is converted into a one-way road after UM football games to accommodate people leaving the stadium. We may determine a set of roads that would yield the most improvement in ingress and egress traffic flow if the traffic direction is reversed, based on the existing traffic data provided by CoD and MDOT and predictive models of road utilization before and after previous special events that can be developed with such data.

We notice a similar trend from various case studies that reverse traffic strategy is more predominantly used for the egress of traffic rather than ingress. Thus, we propose optimizing the reversal of roads to focus on the more concentrated egress traffic after the event rather than the comparably more gradual ingress traffic before the event. One big advantage of this scenario is that Detroit is surrounded on three sides by freeways (M-10 to the west, I-75 to the north, and I-375 to the east) and the Detroit River to the South. As a result, we may design the reallocation of the one-way roads to go radially out of the city rather than forcing drivers in one direction, giving drivers more options and reducing congestion. The shockwaves caused by drivers' late lane switching movements due to correcting their turn lanes are the main cause of city congestion, so determining the exact routes to be converted would decrease the number of lane switches by drivers.

One example of this effort is having a common exit for all vehicles on each street. Although there exist more options in total to exit the downtown, each location within the downtown will have a specific path that all vehicles will follow. From Detroit, we are certain that most of the traffic will be headed westward due to major connections (airport, rail, etc.) and cities' locations, so we may prioritize our design to account for the heavier load of westbound traffic. In summary, designing the conversion into one-way streets throughout Downtown Detroit in a way that follows these above principles to reduce traffic congestion, while taking into account the uniqueness of the geography and road network.

2.4 Information provision

The importance of information sharing should not be neglected as any solution loses its purpose if people are unaware of such an improvement. We introduce two suggestions to effectively provide transportation-related information to the people.

2.4.1 Dynamic signage

Dynamic signages (Figure 12) are simple installation options to directly increase people's awareness of real-time changes. Various information such as parking spaces, detour routes, estimated travel times, and road closures can be displayed on these signs in real-time to respond to current traffic conditions and manage traffic flow and congestion. Also, *automated flaggers* (Figure 13) can help temporarily manage the flow of vehicles and pedestrians at intersections and crosswalks without a man, especially in areas close to event venues.

Figure 12: Dynamic signage.

Figure 13: Automated flagger.

2.4.2 Integrated platforms

We further suggest developing *digitally integrated platforms* in order to enable information sharing among all parties involved for more efficient traffic management. Such platforms may serve several purposes. For instance, a real-time message push (Figure 14) to the users' cellular devices or to dynamic signages can broadcast real-time traffic information, road conditions, and safety emergencies in the user's nearby areas. Second, a parking management API (Figure 15) may provide optimal parking recommendations, real-time remaining parking quantities, and estimated parking costs.

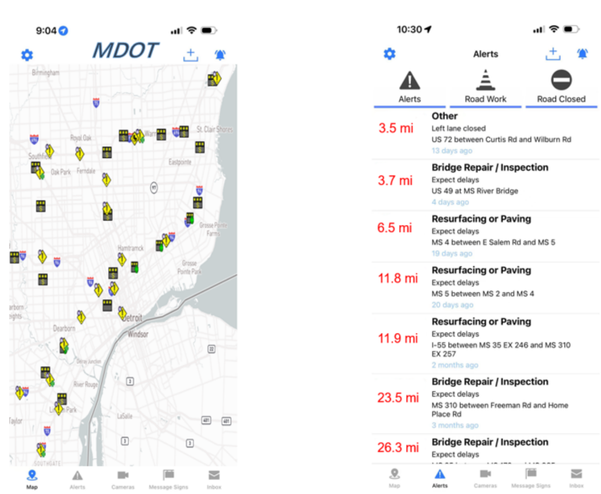

Figure 14: Traffic information.

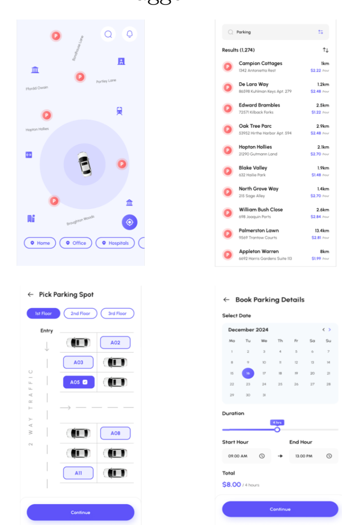

Figure 15: Parking management.

Table 1: Cost breakdown of the solutions.

Description	Quant.	Unit Price	Subtotal
Variable Message Signs	14	$ 8500	$ 119,000
Temporary Striping Installation and Removal	1080	$ 25/foot	$ 27,000
Cones for Maintenance of Traffic	250	$ 22/cone	$ 5,500
Planter Boxes for Beautification and Pedestrian Protection	20	$ 450/box	$ 9,000
Real-Time Traffic Light Controller	4	$ 1,800	$ 7,200
Integrated Platform	1	$ 20,000	$ 20,000
Increased bus lines	3	$ 10,000/lane	$ 30,000
Total cost			$ 217,700

3 Solution Analysis

3.1 Concept of operations analysis

We devise a concept of operations (Con-Ops) analysis of our solution proposals in three architectural structures: functional, physical, and enterprise architectures. Each architecture is interrelated, and the whole system should be examined as a whole.

First, functional architecture demonstrates how the features (functions) of the physical objects assist the overall structure of the operations. Many details are shown in the solution, and some of the physical and functional object architecture is summarized in Figure A.1.

Second, physical architecture explains how physical objects and agencies cooperate with each other as it is referred to as ITS service packages TM01, TM03, PT03, and VS12 [6]. The physical architecture of the proposed solutions is shown in Figure A.2.

Third, in the enterprise view, physical objects and functional objects are also depicted as resources, in the context of the organizations that are involved, and the roles they play. The enterprise architecture is presented in Figure A.3. All figures are shown in Appendix A.

3.2 Cost breakdown and Timeline

Another pivotal solution analysis is providing cost estimations and projected timelines for implementing such solutions.

We foresee that the majority of the monetary cost would incur from infrastructure development solutions, and the demand forecasting and policy planning solutions require a much smaller budget. As such, we provide the estimated cost breakdown for such solutions in Table 1. Another crucial consideration is the expected implementation time for the proposed solutions, and the projected timeline for the three solution pillars and the demand forecasting aid is shown in Table 2.

Table 2: Solution projected timeline.

Task	Est. Time
Roadway Design and Signage Placement	3 months
Parking Hub Search	3 months
Traffic Impact Studies	1 month
Temporary Restriping and Installations	1 month
Park-and-Ride Shuttles Preparation	1 month
On-site Event Preparation	2 weeks
Reverse Traffic Planning	2 weeks
Demand Forecasting Data Collection	1 month
Model Training and Prediction	1 month

4 Anticipated Outcome

We anticipate the impacts of the solutions proposed to span over five categories: operational, safety, mobility, environmental, and economic benefits.

- **Operational benefits:** As noted, NFL has major control over event logistics in the downtown area. However, MDOT and CoD may extend their planning to the surrounding metropolitan areas and freeways, which are regions not controlled by NFL, to accommodate better ingress and egress of traffic. Operational costs of different services may decrease through proper coordination among different

stakeholders, and providing integrated platforms can reduce the need for man force, subsequently decreasing labor costs during the event weekend.
Another consideration of CoD is to predict various traffic scenarios that may occur during the event weekend. The demand forecasting effort emphasizes such a need, and a case study from the previous event shows that such a prediction is valid.

- **Safety benefits:** Safety is of utmost concern for pedestrians and micromobility users, and providing dedicated road infrastructure and pedestrian-only zones for those users significantly promotes their safety. In addition, platforms to inform eventgoers and local community members with real-time information and services support their safety.
Providing connecting services, e.g., a park-and-ride system, extends such efforts by providing safe last miles for participants of the event. Such services also ensure drivers' safety as they can locate parking spaces more easily, and their routes are separated from those of pedestrians.

- **Mobility benefits:** As noted, the solution reduces potential pedestrian accidents, and as a consequence, it will improve mobility in the region. Securing parking locations and first-and-last miles are critical for people's participation in the event. Redesigning lane usage and park-and-ride systems can support such security, and integrated platforms can inform people with such information in real-time. The solution will also lead to the improvement of the existing ITS system and enhance the information communication among different centers and provides more real-time and accurate data for traffic analysis.
Furthermore, facilitating the increased demand in and out of the city needs to be planned for, and a reverse traffic solution prepares for such an unprecedented traffic surge.

- **Environmental benefits:** Traffic demand is expected to significantly increase during the event. As such, CoD should brace for the environmental negativity that such a surge can bring. First, public transportation systems reduce miles driven by individuals, having a considerable impact on the air quality and the environment in the city. Also, providing people with accurate and real-time information prevents people from driving unnecessary miles, a byproduct of which is curbing the environmental footprint of the event. The estimated environmental benefits include reducing fuel consumption and vehicle emissions and decreasing the demand for traveling by car. Encouraging more energy-efficient travel modes, such as public transportation, directly boosts such benefits.

- **Economic benefits:** Economic factors should not be neglected in hosting such a major event. As noted in operational benefits, the solutions reduce transit operational costs and labor costs. Additionally, as more participants may be involved in the event, local businesses and vendors will benefit from such an increased need. Finally, it is our hope that the successful hosting of the event will provide positive experiences to the participants, improving the overall image of the city.

5 Conclusion

The UM team "The Wolverines" considers transportation operations for the 2024 NFL draft event held in Detroit, Michigan. The team provides a series of concept-of-operations solutions, divided into three pillars: infrastructure improvement, traffic management, and information provision. All solutions are informed by a demand forecasting tool that predicts the surge of demand during the event weekend.

The infrastructure solutions advocate for the reallocation of road infrastructure to facilitate various modes of transportation and improve the safety and mobility of the participants. The traffic policy solutions demonstrate customized ways to control and serve the visitors to the city during the event. The information provision solutions assure real-time information is well communicated to the people, increasing their safety and participation. These solutions can be implemented individually or combined, depending on the available resources.

We then examine Con-ops and the anticipated benefits of the recommended solutions, scrutinized from various viewpoints. In conclusion, we believe the solutions presented will promote pedestrian safety and comfort, participants' experiences and engagements, and the city's gain from the event, in both the short and long term.

References

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A Con-ops Architecture

This appendix includes visualizations of functional, physical, and enterprise Con-ops architecture.

Physical Object	Functional Object	Description
Traffic Management Center	TMC Intersection Safety	Provides real time information of traffic conditions to ITS and proposed installations.
Transportation Information Center	TIC Traffic Control Dissemination	Communicates with TMC(s) and provides transit operation information to vehicles, pedestrians, and devices.
ITS Roadway Equipment	Motion & Gait Sensors	Infrastructure at local roads that senses pedestrian movement to adequately predicts time of crossing.
ITS Roadway Equipment	Roadway Signal Control	Field elements such as signal controllers, detectors, conflict monitors, and signal heads that control signalized intersections to accommodate increased demand.
Public transportation (Bus, Qline, etc.)	-	Provide connections between parking and visitor hubs and event cites.
Integrated platform	Visualizations	Provide real-time traffic and transit information.
Integrated platform	Alerts	Provide real-time traffic and transit information.
Integrated platform	GPS service	Provide park-and -ride system for virtual hubs.
Installations	Message alerts	Provide real-time traffic and detour information.
Installations	Traffic control	Manage traffic flow and greed/red lights based on real-time traffic data.
Transit hubs infrastructure	-	Improve or develop transit hubs locations to increase safety and comfort of the users.

Figure A.1: Functional architecture.

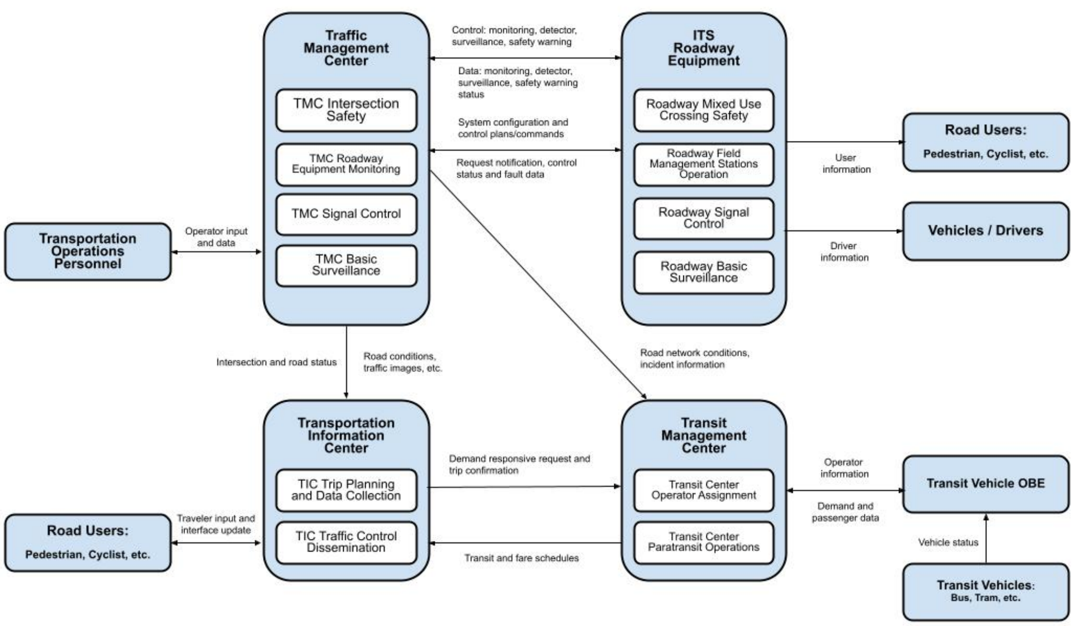

Figure A.2: Physical architecture.

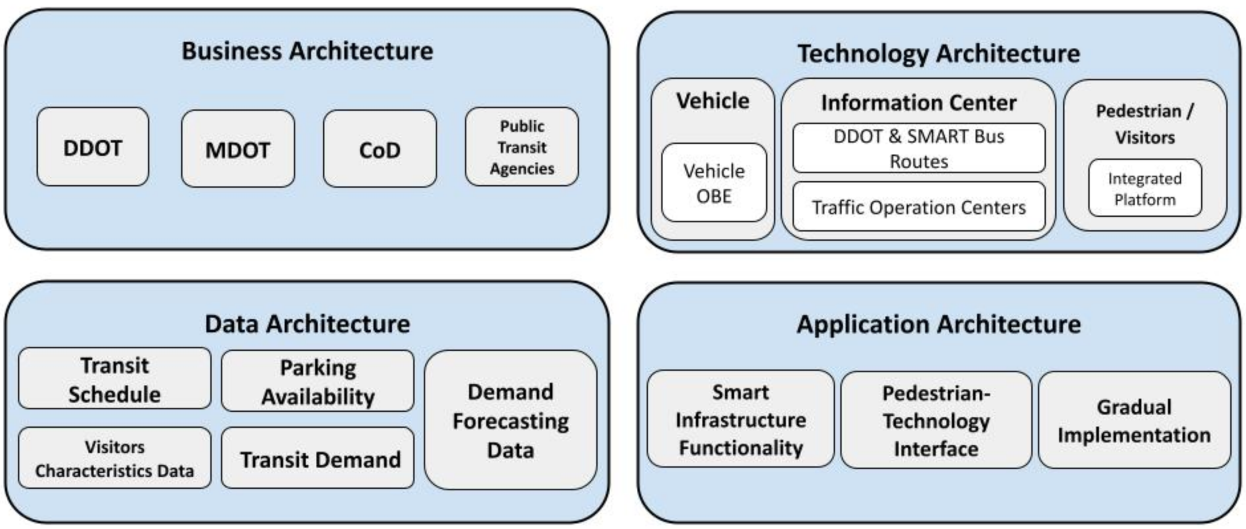

Figure A.3: Enterprise architecture.