Smart Transport System: The Role of Technology in the Efficient Management of Traffic Situations in EDSA

A Concept Paper

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ABSTRACT

This concept paper is the first part of a three-fold system for an efficient management of the traffic situation in EDSA. This paper focuses on the commuting service and transport system introduced here as Smart Transport System (STS). The solution offered is the use of Contactless cards as mode of fare payment, the installation of Smart Bus peripherals, Smart loading and unloading stations, and Smart Bus terminals. The second part, which is underway is the introduction of the Smart Traffic Operations Procedure (STOP). And the last and final part of the total solution of traffic problem is the institutionalization of Road Safety and Traffic Education (RoSTed) in Philippine schools and local communities.

Keywords: Automated Fare Collection (AFC), Smart Ticketing System (STS), Smart Bus, Smart Station, Smart bus terminal, GPS, NFC, QR-Codes, Contactless cards

I. INTRODUCTION

Next to Climate Change, the most pressing problem lurking on the Philippine horizon nowadays is Traffic congestion. Both public transport commuters and private car owners are experiencing the horrendous effect of a snail-paced traffic engulfing almost all main thoroughfares in Metro Manila. Travelling within the Metropolis, from one city to another is no longer a joy ride but an “ordeal” that is causing mental, emotional and physical fatigue to travelers. It can be considered as a “man-made disaster” increasing daily in gravity and victimizing young and old in all walks of life.

Traffic congestion and traffic discipline are perennial topics of discussion at coffee shops and in meeting rooms throughout Metro Manila. It is an accepted fact that congestion hinders the smooth flow of goods and services due for the public. It also contributes significantly to pollution, and costs billions of pesos in wasted fuel, time and productivity. Many studies have been conducted aiming to come up with solutions, and huge amount of money was spent for years, but with very little real improvement to show for the expense.
II. THE PROBLEM AND ITS BACKGROUND

Traffic congestion is prevalent primarily in the cities, particularly Quezon City, Manila and Makati. The main avenues of these cities, EDSA in particular, and even the secondary roads are often congested, and the problems of traffic congestion have become so serious that the economy is severely affected. To describe the magnitude of the traffic problem, EDSA was even dubbed as the largest parking lot on earth due to heavy traffic rendering vehicles stuck for hours along its stretch.

A. Impact on the Economy

In a recent report it released, the Japan International Cooperation Agency (JICA) said that despite the Philippines’ better-than-expected economic growth, “the Philippines risks losing to P6 billion a day by 2030 because of worsening traffic jams.” The JICA said that the costs of traffic will continue to rise if adequate solutions to ease congestion are not immediately implemented.

Additionally, the Philippines lost P1.513 trillion in the 10 years to 2011, particularly during the rainy season. A study by the National Center for Transportation Studies (NCTS) showed, computing the fuel costs and potential man-hour lost while stuck in traffic.

According to the study, the possible additional costs from fuel add up to P4.212 billion a year, plus the time wasted which could have been spent for production, trade and business, the average annual cost of traffic congestion in the National Capital Region is P137.519 billion.

Thus, the cumulative cost of 10 years of traffic in the Philippines has amounted to P1.513 trillion. Such great amount could have been added to the National Budget of the government and utilized in rendering some basic services that benefits the citizenry.
B. Impact on the Environment

Moreover, traffic congestion in the Metropolis, described by some witty minds as “carmageddon” (to emphasize its horrendous effects) has also its negative impact on the environment and general health of the populace. According to the Secretary of Department of Environment and Natural Resources (DENR) Ramon Paje, it has been observed that **70 to 80 per cent of air pollution in Metro Manila is caused by motor vehicles, and only 20-30 per cent is caused by emissions from industries and other stationary sources.**

Vehicles stuck for hours in the middle of traffic, render their motors idling for a long period which means there is a great amount of gas emission that pollutes the air we breathe.

Hence, **traffic problem is also a contributing factor to Climate Change** – one of the major concerns of our government today, since our country being archipelagic in nature is found to be the most vulnerable, among Asian countries, to extreme events brought about by the effects of Climate Change.

Another form of pollution caused by traffic congestion is noise pollution. Just imagine a thousand of vehicles idling in unison for a long period of time. There is literally an orchestra of different sounds that is being amplified by the concrete jungle that we have in the Metropolis instead of having trees that could serve as noise barriers and absorbent of carbon dioxide.

C. Impact on Health

Traffic congestion has also its “hidden toll” on health and well-being of the general public. According to a report from the World Health Organization (WHO) the growing incidence of cancer, respiratory ailments and other non-communicable diseases (NCDs) are found to be associated with factors such as **traffic congestion, pollution** and other **stresses**. This health issue, the report added, will be costing the country up to 6 per cent of its gross domestic
product (GDP) by 2030 unless the government is able to reduce such above-mentioned factors. At present, the impact of NCDs on the local economy was estimated at 3.5 per cent to 4 per cent of GDP, according to Peter Sheehan, research director at Australia’s Victoria Institute of Strategic Economic Studies.

NCDs, as defined by the World Health Organization (WHO), are also known as chronic diseases which are not passed from person to person. The four main types of NCDs are cardiovascular diseases (like heart attacks and stroke), cancers, chronic respiratory diseases (such as chronic obstructed pulmonary disease and asthma), and diabetes.

The latest WHO data showed that NCDs kill 38 million people each year worldwide, and almost three quarters of the NCD deaths (roughly 28 million) occur in low- and middle-income countries.

Another startling report about traffic congestion’s effect on health was made by Robert Lee Holts in his article published in a US Health Journal on November 8, 2011. It carries the banner, “Scientists Increasingly Link Vehicle Exhaust With Brain-Cell Damage, Higher Rates of Autism.”

According to the report, as roadways choke on traffic, researchers suspect that the tailpipe exhaust from cars and trucks—especially tiny carbon particles already implicated in heart disease, cancer and respiratory ailments—may also injure brain cells and synapses key to learning and memory.

New public-health studies and laboratory experiments suggest that, at every stage of life, traffic fumes exact a measurable toll on mental capacity, intelligence and emotional stability. "There are more and more scientists trying to find whether and why exposure to traffic exhaust can damage the human brain," says medical epidemiologist Jiu-Chiuan Chen at the University of Southern California who is analyzing the effects of traffic pollution on the brain health of 7,500 women in 22 states.

Moreover, recent studies show that breathing street-level fumes for just 30 minutes can intensify electrical activity in brain regions responsible for behavior, personality and
decision-making, changes that are suggestive of stress, scientists in the Netherlands recently discovered. Breathing normal city air with high levels of traffic exhaust for 90 days can change the way that genes turn on or off among the elderly; it can also leave a molecular mark on the genome of a new-born for life, a separate research teams at Columbia University and Harvard University reported.

Children in areas affected by high levels of emissions, on average, scored more poorly on intelligence tests and were more prone to depression, anxiety and attention problems than children growing up in cleaner air, separate research teams in New York, Boston, Beijing, and Krakow, Poland, found. And older men and women long exposed to higher levels of traffic-related particles and ozone had memory and reasoning problems that effectively added five years to their mental age, other university researchers in Boston reported this year. The emissions may also heighten the risk of Alzheimer's disease and speed the effects of Parkinson's disease.

"The evidence is growing that air pollution can affect the brain," says medical epidemiologist Heather Volk at USC's Keck School of Medicine. "We may be starting to realize the effects are broader than we realized."

D. Social Impact

In the social aspect, study shows that traffic congestion also has negative impact on workers’ productivity and adversely affects students’ performance in school as well. Unpredicted traffic, especially during rainy season is the main cause of tardiness for both employees and students. Being stuck on traffic for a long time also brings pressure to both of them, thus causing downturn of their mental and physical energy that is supposed to be exerted in work and study activities.

Some studies also found out that traffic problem affects family relations. Parents’ time to bond with their children became limited because such precious time that is supposed to be spent
with their kids at home is being spent in agony while inside their private car or public transport due to snarling traffic in EDSA and other main thoroughfares.

It is also noteworthy, that in some studies conducted, it has been deduced that traffic congestion in the Metropolis is relatively contributory to crime and poverty. Data from the Police reveal some traffic-related violence resulting to homicide or severe physical injury.

**E. Ranking in Traffic Situation**

Based on 2015 Traffic Index from *Numbeo.com, the Philippines is fourth (4th) among Asian countries and placed ninth (9th) in the world in terms of negative traffic situation, a recent report from the Philippine Star showed.

Numbeo.com, which compares traffic data from 88 countries, released 2015 statistics on average commuting time, commuting dissatisfaction, traffic inefficiencies and carbon dioxide emissions in commuting.

The Philippines has **202.31 points** in the traffic index, ranking it just above neighboring Thailand with **200.79** points out of the perfect score of one (1). Bangladesh, meanwhile, has the worst traffic in Asia with a score of **280.43**.

Average one-way commuting and traveling time in the Philippines reaches **45.50 minutes** before workers reach their destination, the Numbeo.com data indicate.

The long commute in the Philippines also spurs a dissatisfaction rate of **3,724.39** on the index, which assumes that discontent increases exponentially with each minute after one-way commute time is longer than **25** minutes.
The index also indicates the country's traffic inefficiencies at **217.82** assuming driving and commute times vis-a-vis economies of scale.

Kenya topped the index with a score of **317.24** as worst in the world, while Turkmenistan received a score of **45.49** for having the most efficient traffic management.
F. Causes of Traffic Congestion

Studies conducted by lead agencies (DOTC, MMDA and Traffic Management Centre), academic institutions and non-government organizations were able to identify several root causes of traffic congestion in Metro Manila. These causes can be generally classified into four: behavioral, volume-based, technological and ministerial.

1. **Lack of Discipline** is observed to be the most disruptive of congestion-causing behaviors. Indeed, there can never be order but chaos in the roadways without discipline. Brown (2011) in his paper vividly states that in the case of Metro Manila traffic, most of the congestions is caused by only a few types of disruptive behavior, and these are the following:

   - Public bus/jeepney behavior
   - Turn-lane behavior
   - Intersection behavior
   - Pedestrian behavior

   He suggested that managing these behaviors should be the initial focus of any effort to impose order on Metro Manila roadways. In his paper, he discussed the problems associated with each, and offered strategies to manage them. **The proponents of this Project believe that 50 % of the traffic problem can be resolved if discipline-imposing tools and mechanism are properly installed and managed by disciplined traffic enforcers.**
2. **Laxity in Enforcement of traffic rules and regulations.**

This also falls under the behavioral domain of traffic congestion cause. We have enough traffic laws to enforce but they are simply not strictly enforced. The abovementioned behaviors can easily be managed and controlled if the law enforces themselves are disciplined enough to do so. But because they themselves are wanting in self-discipline they are prone to corrupt practices and this leads to the perpetuation and aggravation of the traffic congestion here in Metro Manila and other highly-urbanized cities in the country.

One very important element of enforcement is the enforcement of ORDER. There are so many road markings and traffic signs intended to impose order in the roads but they are just being simply ignored. **There is a collaborative infraction of traffic rules among the pedestrians, commuters, drivers and the enforcers themselves.** Again, this is another issue of discipline for both perpetrators and traffic enforcers. Violation can only be controlled by strict imposition of the rule of law and order. And this entails **an effective traffic management system manned by disciplined enforcers and guided by technological support system.**

3. **Volume of vehicles plying the streets of Metro Manila is one of the major causes of traffic congestion.**

According to a report from the Traffic Management Centre (TMC), there are more or less **316,345 vehicles per day that are travelling through, EDSA Highway as of May 2009, of which 12,689 are buses.** Considering the rate of acquisition per year, say for example **1000/year,** there is an addition of **6,000** more vehicles going to and fro EDSA this year, 2015. By using simple mathematics traffic problem could easily be quantified. It is the simple formula of volume and space. We continually increase the volume (vehicles) without increasing space (roadways and other infrastructure). This is due to the fact that we don’t phase out or retire old vehicles. Instead, our present system allows the importation of second hand vehicles and then recycle them for use.
Additionally, we have so many forms of vehicles. Added to the jeepneys and taxis are tricycles and pedicabs plying interior roads that could serve as alternate routes for main transport vehicles (when needed) but can no longer be used because they are already congested, and worst some became permanent parking spaces of some irresponsible residents. **Statistically, we have more vehicles than our existing roadways could accommodate.**

4. **Poor and Inadequate Infrastructure is another major cause of traffic problem.**

Taking from the above discussion regarding volume and space, volume and space can be increased simultaneously without defeating the purpose of solving traffic congestion. This is by constructing multi-layered road networks to accommodate mass transportation system (MTS). And this MTS includes not only the physical roads, rails and bridges but also technological infrastructure that will guide and support such system.

This long term and ultimate solution for traffic congestion in Metro Manila has already been done. The **Japanese International Cooperation Agency** or JICA has already presented a proposal to the Philippine government on how to improve the country’s transportation system. The proposal is packaged as a “dream plan” and outlines short-term and long-term developments. If and when implemented, it will cost the government around **P2.3 trillion.**

To summarize, JICA's innovative proposal called **"Intelligent Transport System"** or ITS which will maximize existing road capacity is doable as it calls for better traffic engineering and management by requiring **"geometric improvements, pedestrian facilities, traffic surveillance, accident prevention, traffic safety education, and traffic enforcement."**

The JICA Philippines Senior Representative Eigo Azukizawa has noted that JICA's recommendation of ITS **"requires a signal control system, travel time prediction, road maintenance, intelligent parking, incident detection, and bus scheduling assistance among others. By putting modern technology and discipline into traffic management, the JICA study said the Philippines can make better use of available infrastructure."**
5. There is a need for new Laws that will support the implementation of recommended solutions to traffic congestion.

One very urgent law that is needed to be passed is the Law of Reduction. This pertains to a law that provides for the phasing out of old vehicles and regulation of acquisition for new vehicles. Another legal matter that is urgently needed is a law that provides for establishing an Intelligent Transport System (ITS) backed up by an advanced technological infrastructure. This is in preparation of the anticipated implementation of the “Dream Plan” prepared by JICA and has been approved by the President. All initiatives, recommendations and programs of action leading to the solution of traffic problem will go down to drain without laws and policies that will pave the way for implementation.

Hence, this Project Proposal is anchored on three major principles: leaders’ political will, integration and interoperability.

Political will is a major factor in solving the present traffic problem. Our government officials first and foremost must “think out of the box” and be adaptive to change rather than resistant to it. They must also be sensitively receptive to doable recommendations (like that of JICA’s “Dream Plan”) and set immediately implementation strategies.

Integration as per this proposal refers to pooling of resources, i.e. financial, technological, and managerial in order to come up with a holistic and consolidated approach to the problem. Funding is the oil of the project, technology will be the vehicle and a management entity will be the driver that would manage the implementation of the Project.

In an Integrated Public Transport System cooperation of major stakeholders is a must and could also be a major barrier once not achieved. Public transport operators, commuters, IT companies and service providers should agree in a single scheme or standard of operation. Particularly when smart ticketing system is utilized as proposed in this Project, because it would require standardized fare scheme for all public utility vehicles.
III. PURPOSE AND SIGNIFICANCE OF THE PROJECT

The purpose of the Project is three-fold. First, it aims to establish a proof of concept on the utilization of Automated Fare Collection (AFC) via Smart Ticketing System (STS) on public transportation, particularly buses, and to be expanded soon to taxicabs and UV express transport group.

Second, since the overarching objective of the Project is to provide at least part of a solution to traffic congestion in Metro Manila, the proponents also aim to pilot-test a technology driven Smart Busses and Smart Loading and Unloading Station focused on monitoring traffic related activities like travel time prediction, bus scheduling, incident detection, and traffic violations among others.

And third, this Project also aims to address a very salient component of solving the traffic problem, and that is education. As identified at the outset, lack of discipline is the major behavioral cause of traffic congestion. To address this concern the proponents will be designing educational materials on Traffic Education and for the sake of institutionalization, eventually, it will be proposed as supplementary learning activity in the elementary level.

This is in cognizant to a new Bill (House Bill 4160) authored by Congressmen Rufus Rodriguez (2nd District, Cagayan de Oro City) and Maximo Rodriguez, Jr. (Party List, Abante Mindanao). Said new Bill, if passed into law, shall be known as the “Road Courtesy, Discipline, and Traffic Safety Education Act.” Such law mandates that Road Courtesy, Discipline and Traffic Safety Education will be included in the curriculum of elementary and secondary schools.
IV. PROJECT DESCRIPTION

A. Goals and Objectives

The main goal of this paper is to alleviate the worsening traffic in EDSA and address the problems mentioned in the Problems and Backgrounds.

To make commuting easy and convenient for the commuters using cashless transactions, secured travel, road safety in EDSA, and improve the economy by moving goods and services faster.

To create a new form of cashless transactions for the Filipino people wherein goods and services will not require payment of cash, thus, will create more opportunities in exploring Technology based economy.

To efficiently collect taxes for the sale of goods and services via electronic means of tracking purchases which will lead to eliminating tax evasion and misrepresentation.

To serve as a model concept which can be adopted by every city all over the Philippines.

B. Methodology

Automated Fare Collection

The commuter will buy contactless cards or E-Cards from a buying station or any distributors e.g. 7-11, mini-stop, family marts, and other retailers. This Fare Card will be used by the commuters for boarding and un-boarding in the bus. The Fare Card can be reloaded in any loading station (just like cellphone reloading) or in designated loading machine.
Where to buy and load E-Cards

Convenience Stores

Malls/Concierge

Self Service Kiosk

How to purchase E-CARD

BUY

Buy E-Card
Press “Buy E-Card” button
Insert Money
Get “E-Card”

How to reload E-CARD

Reload
Press “Reload” button
Insert Money
Tap Card
From the bus loading station the commuter will board the bus and tap it on the contactless card reader. The card reader will show the amount remaining in the E-Card and will be charge from the station the commuter boarded up to the last station, this will ensure that the commuter had enough remaining balance for the commute. If the E-Card does not have enough account balance, the card reader will make an audible sound and will flash on the screen that the commuter does not have enough balance for the commute. The system will then relay the message to the drivers on-board dashboard monitor so that the driver will be informed of the situation. The passenger will then be politely asked to un-board the bus.

When the commuter wishes to un-board the bus in a station, the commuter will then again tap the card reader and the exact fare will be debited to the account. Since the card was initially charge the full amount to the last station, the card reader will return the corresponding rebates to the card load. This will ensure that the exact amount was rendered.

This Automated Fare Collection will ensure that there is no cash transaction between the commuter and the bus operators. At present the bus operators have a conductor and a driver at one time. The conductor collects the fare and issues tickets for the journey and the driver is concentrating in driving. With this new AFC there is no need for conductor since the transaction is automatic and there is no need to issue tickets since there is an automated debit form the E-Card. This will save the bus operator in manpower.
and thus reducing operating cost. This will also eliminate the use of paper tickets and thus reduce the use of paper in every transaction, which in turn help save the trees.

This is also an added security measures in the part of the commuters since they don’t have to carry cash for paying their commute and also for the bus operators since there is no cash that will exchange hands from the commuter and the bus operators. This will also assist the bus operators in auditing since every transaction is automated. The bus operator need not audit the driver or count how much was earned in every trip. The transactions can be viewed via secured internet connection, just like viewing an online banking transaction. The bus operator can log-in to the secured website of the AFC and they can view how much money was earned in real time, how many trips every bus has taken, how many trips all of their buses had taken and how much was earned by each bus or all of their busses.

The amount of the transaction of all the bus of the bus operators will be deposited in their account daily, weekly, bi-monthly or monthly depending on the result of the negotiation between the AFC provider and the bus operators. The tax will be automatically withheld from the earnings of the bus operators, this will ensure proper tax is collected by the government and the bus operators need not worry about tax payment.

The government can also efficiently and correctly collect taxes from the sale and loading of the E-Cards, since the transaction is digital the government can easily audit the tax payment or the tax payment can be automatically deposited to the government daily, weekly, bi-monthly or monthly.

There will also have an earning in the form of advertisements in the E-Cards since this is a long time ownership of the E-cards companies can have their logo or products printed on the E-Cards. The government can also collect tax from this advertisement in the form of earnings of the AFC provider.
Each E-Card will have a unique Identification Number for security purpose. The transactions will be recorded in the chips embedded in the E-Cards. If the E-Card is damaged or not readable by the card reader, the commuter will not be allowed to board the bus. In any case that the card was damaged while the commuter is inside the bus and the E-Card is not readable upon un-boarding, the amount will be debited from the load and commuter can have their E-Card replaced.

This AFC will eliminate overloading bus, since the card reader will also count the number of passengers who boarded the bus and un-board the bus. If the bus is on its full capacity, the card reader will not allow charging anymore. The driver can then politely decline the commuter. In any case that the driver will allow the passenger, even though the bus is already in full capacity, the on-board video camera recording will capture the incident and the on-board dashboard monitor of the driver will show that there was an attempt to load the bus beyond its full capacity. When the bus reaches the nearby bus station the on-board dashboard will communicate to the display monitor in the bus station to relay information on how many was on-board the bus and how many had alighted the bus. The display monitor in the bus station will alert the officer that there was an attempt to overload the bus since the driver allowed the commuter to board the bus without paying, that passengers E-Card will be detected by the card reader and the officer can take over from there.

For future use, the AFC can be used as payment to shopping malls, fast food stores, convenient stores, and government transactions to name a few. The AFC can also be used as payment in taxi or other utility vehicles with card readers. The AFC smart card will also be in MRT or LRT as future integration.

**Smart Busses**

All the bus plying EDSA will be equipped with Wireless connectivity, GPS, sensors, touch sensitive dashboard screen, on-board cameras, in-dash camera, card reader machine, and QR-Codes. This will be the initial investments of the bus operators.
Provincial busses plying EDSA will also be included in this system; however, they will have limited functionalities and integration. The provincial busses will only use the unloading bus station and they will not be allowed to pick up commuters along EDSA.

All the bus leaving the bus terminal will slide in their Drivers Smart Card (LTFRB will issue this, there is a separate system for this which is in another project), to the Buses’ on-board Touch sensitive Dashboard Screen. The information of the driver will then be stored in the on-board Touch sensitive Dashboard Screen. The on-board Touch sensitive Dashboard Screen contains the information of the bus. The information are: bus number, driver’s information, plate number, date, time, live video of the road through in-dash camera, capture/send violation button, emergency button, the available seats, maximum capacity, the route, the location of the bus loading and unloading station, total number of trips, the weather, live picture of on-board camera, the number of minutes spent in loading bus station, and any violation.

![Touch Sensitive Dashboard Monitor](image)

The information contained in the black area or the first column will be available to the traffic enforcers and the violation will also be available to them. This will allow for faster apprehension. The driver’s smart card will be scanned by the traffic enforcer for appropriate violation charges.
The second column in the touch sensitive dashboard screen, contain the date and time. The live video feed of the road will enable the driver to report any violation on the road through the capture/send violation button located just beneath the live video feed. This will then be sent to the command center for appropriate action and apprehension of the violation. E.g., a private vehicle is using the yellow bus lane or a vehicle is constantly swerving, the driver can tap the capture/send violation button and the command center will dispatch officers to apprehend the violator. In case of any accident or the bus is malfunctioning, the driver will tap the emergency button and the location, the picture, the location, and video clip will be sent to command center for appropriate action.

The third column contains the number of available seat and the maximum capacity of passengers. This will be shown in the loading bus station monitor as well, this will allow both the driver and the passenger that there are on “x” number of seat available. The live route beneath will show the driver the location of the loading and unloading bus station, this will also allow the passengers in the loading station to know the Estimated Time of Arrival (ETA) of the bus. In this feed the driver will also know the status of the traffic ahead, whether there is an accident, road emergency, and detours. This will allow the driver to make better judgement.

The forth column contains the total number of trips made by the bus; this information will be available to the bus operator as well. This will allow the bus operator to know how many trips a bus had made. This will also show the whether to allow the driver to prepare for rain or any whether condition which will help the driver to make decision on the manner or behavior of driving. This column will also contain the live video feed of the on-board camera so that the driver will see how the passengers are doing or are there any commotion inside the bus, this is also recorded for documentation purposes. This is also an added security for the passenger, in any case that there is an emergency or commotion inside the bus, the driver may call for help using the emerge button in the screen. This will send the information to the command center and the
command center can view the on-board camera for the passenger and the dashboard camera as well. This will allow the command center to do appropriate actions.

The bottom part of the touch sensitive dashboard screen will show the time remaining on the loading station, this will allow the driver to make necessary actions in order not violate the time allowed in a loading station. If there is a violation committed by the driver the screen will also show the violation.

The touch sensitive dashboard screen is tamper proof so no one can tamper it, except the relevant authorities. Anything shown on the dashboard is recorded and can be accessed by the command center. This will also enforce good and ethical driving behavior since the driver knows that his driving behavior is being monitored and recorded.

**Smart Loading and Unloading Bus Station**

The busses will only load and unload passengers in the designated bus stations. There are two types of bus stations: 1) the Loading station and 2) the unloading station.

**The Loading Station**

This is where the commuters wait in line to get boarded into the bus. There will be two queues: 1) for regular passengers 2) for the senior, pregnant, with child, and PWD’s. The priority queue will be the line number 2, to give way for passengers who are differently abled and those requiring special needs. No bus will be allowed to unload passengers in the loading station, this will constitutes violation.

The loading station will have solar panel roof, metal side rail, fiber optic connection to the command center, wi-fi access, messaging boards, screen monitors for advisory and advertisements, lighting, and traffic officers.
The solar panel roofs will supply power to the loading station with backup batteries, in-case a problem will arise from the solar roof panel. The metal side rails will protect the commuters from falling off the ramp. The fiber optic connection will be used to send and receive information to the command center, this will also control the messaging board, screen monitors, and the bus stop systems. This will also allow traffic officers to communicate with the command center. The wi-fi for commuters will allow commuters to access the internet while they are waiting for the bus to arrive.

**Messaging boards and screen monitor advertisement**

The messaging board will provide all the information to the arriving bus. The information are: 1) The bus terminal where the bus is headed 2) The remaining time until the bus leaves the loading station 3) the bus schedule 4) the bus information 5) where to buy smart cards 6) the fare, 7) and other relevant information. The screen monitor advertisement will contain advertisements and announcements. The messaging board will also display the violation of overstaying and other violations the driver has committed during the transit from one station to the other. This will also inform the officer on duty if the bus is overloaded.
The bus loading station will also generate income through advertisements and the government can use the announcement feature for announcements.

**Bus Dispatching Terminal**

The bus dispatching terminal will also have messaging boards and screen monitor advertisements, however this will not be connected through a fiber optic. Instead, the bus terminal monitoring station will be connected via Virtual Private Network (VPN). The bus terminal monitoring station will be used to monitor each bus that leaves the terminal reports and emergencies will also be received in this terminals but the information are limited. The bus operators can access their financials and other information available for them from the command center. This will also encode the driver’s smart cards and the bus information.

The provincial buses where their bus terminals are in EDSA, will also have messaging boards and screen monitor advertisements and they will be connected via fiber optic. Their provincial terminal will also have messaging boards and screen monitor advertisements connected via VPN. The provincial busses will only be allowed to unload commuters in EDSA, they are not allowed to load passengers. After the provincial bus had left EDSA they can load commuters as they travel, however, they are also restricted not to overload passengers. The onboard touch sensitive monitor and the card reader will be able to identify if the bus is overloaded.
The provincial busses will have the same equipment as the city busses and they are also monitored.

Traffic Education

A separate concept paper is created for Traffic Education

Command Center

This is the heart of the projects: 1) Smart Transport System (STS) 2) Smart Traffic Operations Procedure (STOP) 3) Traffic Education. This will control all the traffic in EDSA. This will send and receive information to all the bus, bus terminals, and bus stations.

There will be two command centers in EDSA both strategically located. EDSA will be divided into two sectors and in the middle of the two sectors will be the command center. The two command centers are linked in redundant and secure fiber optic
solutions. All the video feeds will be coursed through the command center. All bus stations and bus terminals will have live cameras connected to the command center.

The command center will have, at its disposal, police officers, traffic officer, rapid response personnel and vehicles, ambulance, temporary first aid bunkers, temporary jail, towing vehicles, first aid and first responders’ team, ICT Team, and operated 24/7. The command center will have two redundant data centers in an undisclosed location.

The officers in the bus stations and bus terminals are 24/7.

C. Initial Systems

**Bus Stop System**

1. Smart Traffic Operations Procedure (STOP) – this is a separate concept paper
2. Bus System Dashboard
3. Driver System Dashboard
4. Bus and bus stations SYNC
5. Command Center
6. Reporting
7. Finance Module
8. Administration/back end

**E-Card System**

1. Purchasing (E-Card)
2. Client Transactions (Automatic Fare System)
3. Reporting
4. Finance Module (Fare Transactions, Vendor Management)
5. Administration and back end
D. Anticipated Outcomes

1. Ease the traffic congestion in EDSA
2. Minimize travel time of commuters
3. Faster bus dispatch
4. Safer more accurate transactions
5. Safer Travel
6. Paperless transactions
7. Bus monitoring
8. Monitor Bus driver behavior
9. Online reports and analytics
10. Improved collection of Tax from Bus Operators and sale of tickets
11. Revenue generation from advertisements
12. Elimination of colorum buses travelling in EDSA

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