PROPOSAL

Electronic Vehicle Registration/Identification

Facilitate Revenue Generation, Reduce Traffic Congestion, Produce Research Data, Enhance Vehicle Regulation Compliance ...

By the

Centre for Transport Planning
University of the West Indies
Cave Hill Campus

January 2009

January 16th 2009

Mr. Lionel Nurse
Permanent Secretary
Ministry of Transport and Works
Pine East/West Highway
St. Michael

Dear Permanent Secretary,

**Re: Invitation of October 2nd 2008 (and variation December 5th 2008)
Proposal for Electronic Vehicle Registration/Identification
MTW Reference No. 2021/2 Vol. I**

Further to your above-mentioned invitation, we are pleased to submit herewith our proposal which outlines our approach to the assignment, our project team, timelines and cost.

We stand ready to discuss and adjust, if necessary, any aspect of our proposal to ensure that we meet and address comprehensively, all of your needs. Please do not hesitate to contact us should there be any queries or issues to be clarified.

Sincerely,

……………………………………………….
George A. V. Belle, PhD
Dean.

cc: Professor Sir Hilary Beckles, Pro-Vice-Chancellor and Principal, UWI Cave Hill

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Section 1 | Background and Introduction

Efficient and innovative transportation systems remain fundamental to development of all countries and regions. In the complexity of the process of sustainable economic development, public transportation undoubtedly plays an important role in helping to achieve national goals. In discussions with the Faculty of Social Sciences (FSS), Cave Hill Campus the Ministry of Transportation and Works (MTW) has voiced its concerns over the issue of domestic transportation. Among the issues emerging were:

- The costs and benefits of public transportation.
- Public transportation and income distribution.
- Given environmental and other potential vulnerabilities, the central place public transportation must play in Barbados' economic development.

MTW subsequently sought FSS assistance in developing a solution to diminish the impact of an inefficient transport system both on our people and movement of goods locally. In your effort to address this major issue of transportation in Barbados, your Ministry has invited the Faculty of Social Sciences to submit a proposal to facilitate enhanced capabilities and operational efficiency in its operations.

Included in the Ministry's "stakeholder" groups in the public and private transport sectors are the police service, public transport operators, private motorists and vehicle insurance providers.

The Ministry seeks to create an enhanced environment to improve transportation capacity, optimize operations, augment revenue generation and facilitate improvement in the area of vehicle crime prevention and detection. We believe that our proposal will

1. **Increase Revenue Generation** and Improve Revenue Collection
2. Enhance **Vehicle Regulation Compliance**
3. Generate "real-time" **Transportation Research Data**
4. Inform on timely strategies and procedures to **Reduce Traffic Congestion**
5. **Optimize Operational Efficiency** for the licensing department and other entities

There are some "unknown variables" which are critical to an effective deployment of an Electronic Vehicle Registration/Identification (**EVR/I**) system.

FSS wishes therefore, that consideration be given to these elements when our "defined" solution is being evaluated.

Some of these unknown elements include, but are not limited to;

- **How tag distribution will be handled** – central or satellite distribution centres to manage tagging approximately 122K vehicles,
- **Commensurate legislation to enable effective enforcement of EVR/I citations** - what exists and what has to be created.
- **Existing (and to-be-aggregated) Database and Interfaces**
  Determination of which interfaces need to be automated and which require human oversight, as well as "ownership of Aggregated data"
  Legal Status of Vehicle Ownership e.g. vehicle owner and commensurate insurance (Corporate Affairs dbf)
  Inspection Procedures and handling of resulting databases
  Police and policing policies and practices.
- **Number of Fixed EVR/I Reader Sites required**

Business Process and Infrastructure Assessment (BPIA)

FSS realizes that the aforementioned "critical variables" are currently either unknown or unavailable. In light of this, FSS proposes an iterative approach to allow MTW to achieve its EVR/I solution smoothly.

Our normal method of engagement employs a **Business Process and Infrastructure Assessment (BPIA)**, a joint process involving local transportation officials, key stakeholders and FSS.

The objective of the **BPIA** is to bring all stakeholders together for a series of meetings to define (and agree) on strategies to address each of the unknown items. It starts with definition of all stakeholders and selecting a spokesperson for each stakeholder group. That person shall possess the competence to make decisions for the particular aspect of the EVR/I programme identified. Some of the issues will require review and research—extant legislation, traffic studies, etc.—to be conducted in order for decision to be made.

In the absence of our standard **BPIA**, FSS proposes an "incremental" solution which will facilitate MTW's acquisition and use of core EVR/I technology to manage and implement its transportation mandate.

Subscription to our proposal will permit MTW to achieve its EVR/I objectives while determining "best practice methods" for Tag distribution, inform on commensurate legislation that would need to be passed/modified, inform on automated interfaces that required for a country-wide rollout and ultimately, speak to the infrastructure which would be required to poll and inventory vehicles on our roadways.

In the following sections we detail our offering with one caveat. Our proposal incorporates an assumption that MTW is responsible for civil works i.e. power at the host and lane site(s), communications equipment, telecom services, and monthly costs to/from Host and lane sites, and poles or mounting structures for fixed reader site(s).

Section	The FSS EVR/I Solution
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3.1 Overview of EVR/I Solution

In the words of Prof. Beckles, Pro Vice Chancellor of the University of the West Indies and Principal of the Cave Hill Campus, "Efficient transportation is the underpinning tenet of efficient and effective industrialization envisioned for our region … Transport is critical to the timely mobilization of appropriately skilled human resources".

Our technical solution will enhance MTW's procedures and practices as they relate to vehicle registration and identification through automating procedures pertaining to motor vehicle inspection, registration and insurance compliance.

There is one imperative for our EVR/I system to be fully effective. EVR/I requires that the necessary legislation be enacted and enforced. EVR/I solution complements appropriately tailored enforceable motor vehicle laws.

FSS offers MTW a unique blend of products, systems and services under our Electronic Vehicle Registration (EVR/I) to enable automated compliance monitoring for a variety of vehicle registration and/or traffic regulations.

Our technology can be used to automate the monitoring and enforcement of Barbados vehicle-specific regulations (e.g., inspection, emissions, insurance and registration), and will help confirm the validity of vehicle and owner data.

The EVR/I System can also be used to monitor roadway usage for any vehicle that appears on an official Government / Law Enforcement "**Wanted**" or "**Of Interest List**". Such lists may reflect vehicles reported stolen, involved in other serious crimes or vehicles for which usage may need, for issues of security, to be monitored. Such vehicles once identified, establish an **"Urgent List"** that triggers EVR/I system operations in a specialized manner additional to its ability to monitor vehicles for registration and/or traffic compliance-related regulations.

A synopsis of our EVR/I follows. Our EVR/I system comprises a geographic infrastructure of fixed reader/antenna combinations, optimized and deployed to monitor vehicles in high-volume traffic areas.

Readers are placed on existing gantries, overpasses or utility poles and/or new poles near the edge of the roadway. Tripod or trailer-mounted Transportable Readers can be provided for mobile deployment by traffic police or for a variety of special operations (such as check-points) required by law enforcement officials.
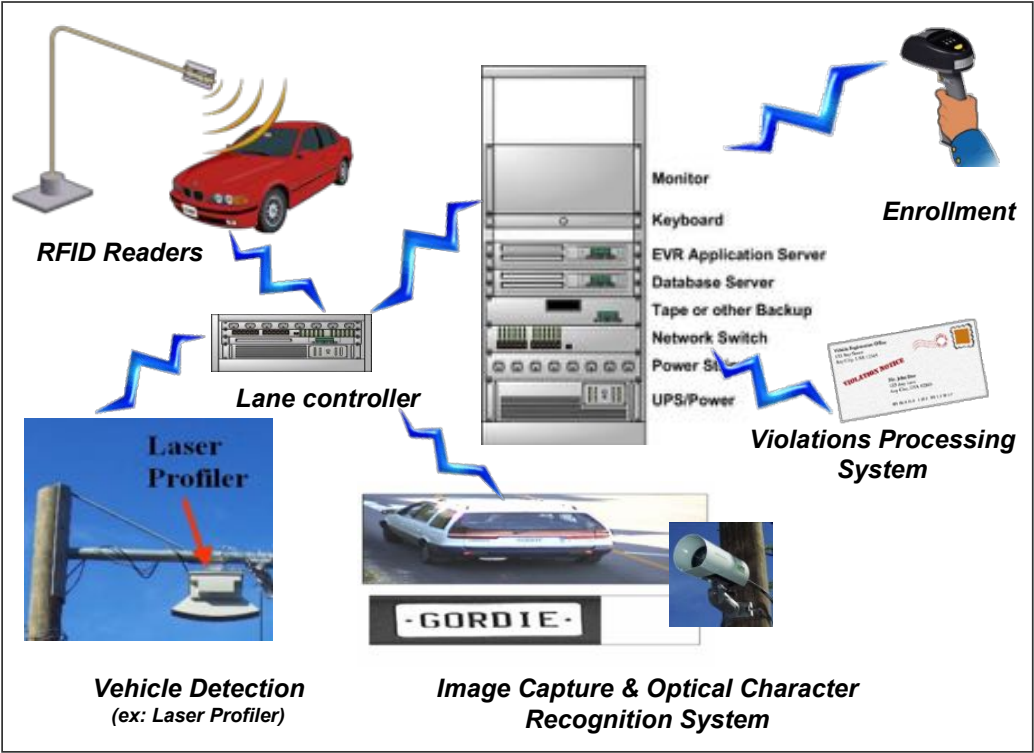
The Radio Frequency Identification, **RFID**-based automated compliance monitoring system feeds and enables a corresponding automated Violation Processing System (**VPS**) which can generate and manage citations distributed after-the-fact via the mail for non-compliant vehicles, or, alternatively, immediately send "alert messages" to law enforcement officials for vehicles appearing on an **"Urgent List"** for immediate vehicle intervention and/or apprehension.

Our EVR/I solution consists of integrated system components that define overall functionality. Without any one of the components, an effective RFID-based EVR/I solution does not exist.

System components include:

- A Radio Frequency Identification (RFID) windshield sticker tag
- RFID readers (Fixed, Transportable, and Handheld)
- Vehicle Presence (Traffic) Detection System
- Image Capture hardware and Optical Character Recognition (OCR) software.
- Lane Controller
- Watch, Of Interest and Urgent Lists
- Back-Office EVR/I database
- Violation Processing System
- RFID readers (Transportable)
- Tag Deployment and Activation

RFID Readers

Lane controller

Monitor
Keyboard
EVR Application Server
Database Server
Tape or other Backup
Network Switch
Power St...
UPS/Power

Enrollment

Violations Processing System

Laser Profiler

Vehicle Detection
(ex: Laser Profiler)

-GORDIE-

Image Capture & Optical Character Recognition System

Section	The EVR/I Process
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Procedure 1 – Enrollment

Once a vehicle, and its owner/driver, pass all Barbados-mandated requirements, the process of electronic vehicle registration begins.

An inspector uses a handheld device to read, and commission, the tag ID in the new RFID sticker tag. The inspector then keys in or scans required vehicle and driver information into the EVR/I Host Software—a central vehicle database system. The handheld scanner uses a wireless connection for real-time communication with the EVR/I Host. The inspector completes the process by attaching the activated RFID sticker tag to the vehicle.

Procedure 2 – Tag Activation

Tag Activation is accomplished by loading Tag ID's into the EVR/I Tag Database. The tags that will be deployed contain a 64-bit unique tag ID preprogrammed into the tag at point of manufacture.

The tag is activated in the EVR/I system when placed on a vehicle's windshield. This is a critical step in the process as authorized officials must ensure that the "right tag is placed on the right (corresponding) vehicle" prior to activating the vehicle into the EVR/I system. The system provides the user the ability to manage a Tag status, as for example, should a tag become damaged or destroyed, or in case the vehicle is lost, stolen.

Once the inspector completes the tag activation process the new data records stored on the handheld are uploaded to the Host Software. Simultaneously with the vehicle's data being successfully uploaded to the central vehicle database, the now redundant data recorded on the handheld is erased.

Procedure 3 – Watch Lists

As long as this unique EVR/I tag record is "commissioned" and the vehicle has a "compliance status", our EVR/I back-end system provides the tools necessary to allow the system to generate a list of compliant and non-compliant vehicles.

This list of vehicles with non-compliant status is called the "Watch List". The Watch List is used by the EVR/I's remote in-lane systems to identify non-compliant vehicles.

A Watch List contains the tag IDs of those vehicles that the system has identified as non-compliant e.g. no inspection, registration, or insurance. Non-renewal of inspection, registration, or post-expiration date insurance data will change a vehicle's compliance status and will result in a Watch List designation for that vehicle.

Additionally, a vehicle's status may be changed as a result of updates from other authorized agencies e.g. an insurance provider signaling that a vehicle's insurance has been cancelled for non-payment of premiums, etc.

Procedure 4 – Compliance Monitoring

At designated lane monitoring locations, special equipment will be installed that will monitor passing vehicles and detect vehicles that are non-compliant.

The equipment that will be installed at each lane monitoring site will include devices such as RFID tag readers, vehicle detection equipment and high speed image capture camera systems. All of these devices are connected to and controlled by a special computer called a lane controller computer.

The lane controller computer runs all of the necessary software components needed to control the in-lane devices, perform all real-time processing of data that is processed by the in-lane devices.

Procedure 5 – Citation Issuance

The rapid availability of vehicle compliance data as well as owner personal data is critical for generating non-compliant notices which are automatically issued to the "owner of record".

This procedure is effected at the Customer Support Centre where all administrative functions and citation issuance will be managed by the EVR/I Host Software.

Procedure 6 – Revenue Generation

For each non-compliance notice issued, specific fees will be levied on offenders for different citations. It is through this means that MTW will be able to generate significant incomes heretofore not experienced by your Ministry.

EVR/I In-lane equipment Setup

Each fixed reader site will be setup so that each time a vehicle passes through the site the following three things happen: the tagged vehicle is detected by the laser detector, the vehicle license plate is read by the camera system and the windshield sticker RFID tag is read by the reader.

The reader, laser detector and camera system are designed to be installed along the side of the road on standard light poles or other overhead roadway-approved structures. The system is a two-pole system (designated Pole 1 and Pole 2) with the poles situated along the road about 50ft (17 metres) apart. The camera system is mounted on Pole 1, pointed up the road so that it will read the vehicle and license plate as it passes Pole 2. The laser scanner system, RFID reader and reader antenna will be mounted to the second pole, Pole 2. As the vehicle passes under Pole 2, the laser scanner will sense vehicle presence and send a trigger pulse to the camera. At this point, the camera will take a picture of the automobile. Simultaneously, the RFID reader will read the windshield sticker tag on the vehicle and send this information back to the lane controller (in a NEMA control cabinet adjacent to the lane). The vehicle data will then be sent to the system back-end described above.

Below is a general description of the in-lane system in Figure 1. Figure 2 shows the roadside NEMA cabinet, Figure 3 the Camera Pole (Pole 1) and Figure 4 the Laser Scanner/Reader Pole (Pole 2).
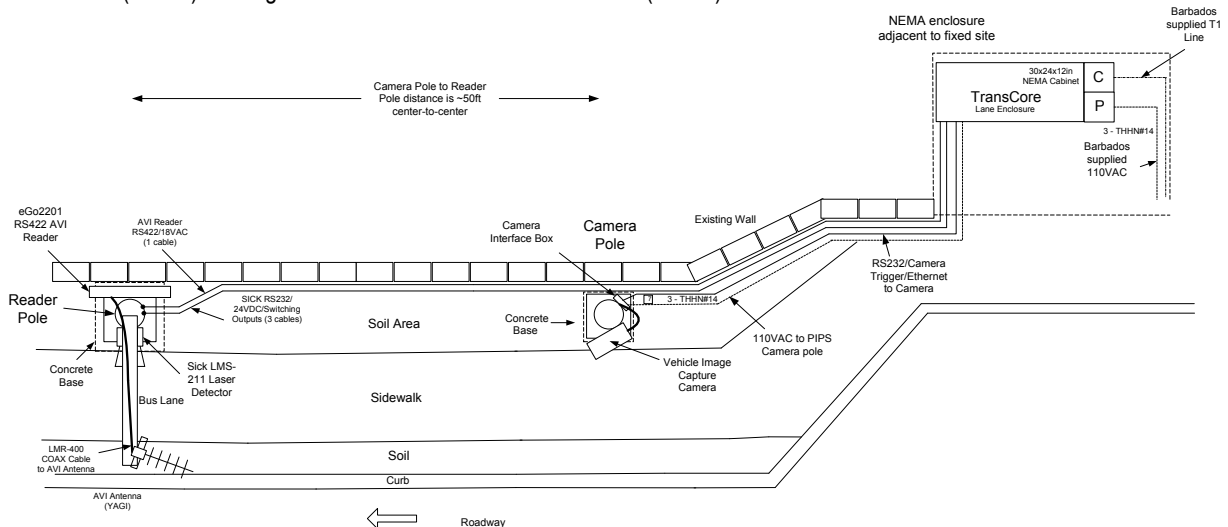
Figure 1: High-level In-lane System with camera pole and scanner/reader pole

Figure 2: Roadside EVR/I NEMA Cabinet

Camera Pole Mounting

15ft Spun
Aluminum pole

Camera
Interface Box

Camera System

Power
connection
(110VAC)

Run wiring
inside pole

RS232/
Camera
Trigger and
Ethernet

15ft   14ft

Traffic lane (Direction
of traffic into page)

Sidewalk   Curb

Conduit to
NEMA control
cabinet

Figure 3: EVR/I Camera Pole (Pole 1) Mounting

Reader Pole Mounting

Figure 4: Scanner/Reader Pole (Pole 2) Mounting
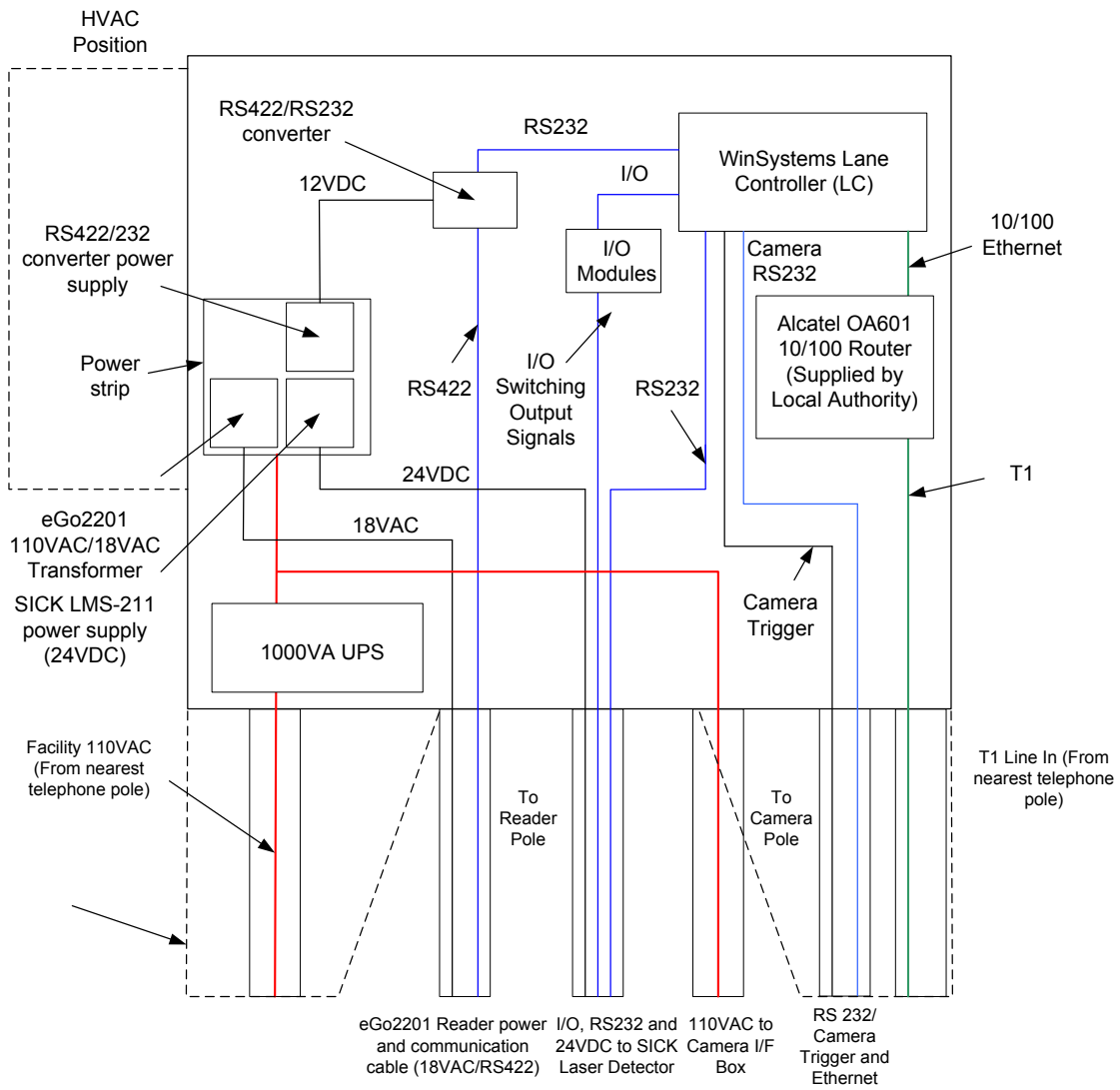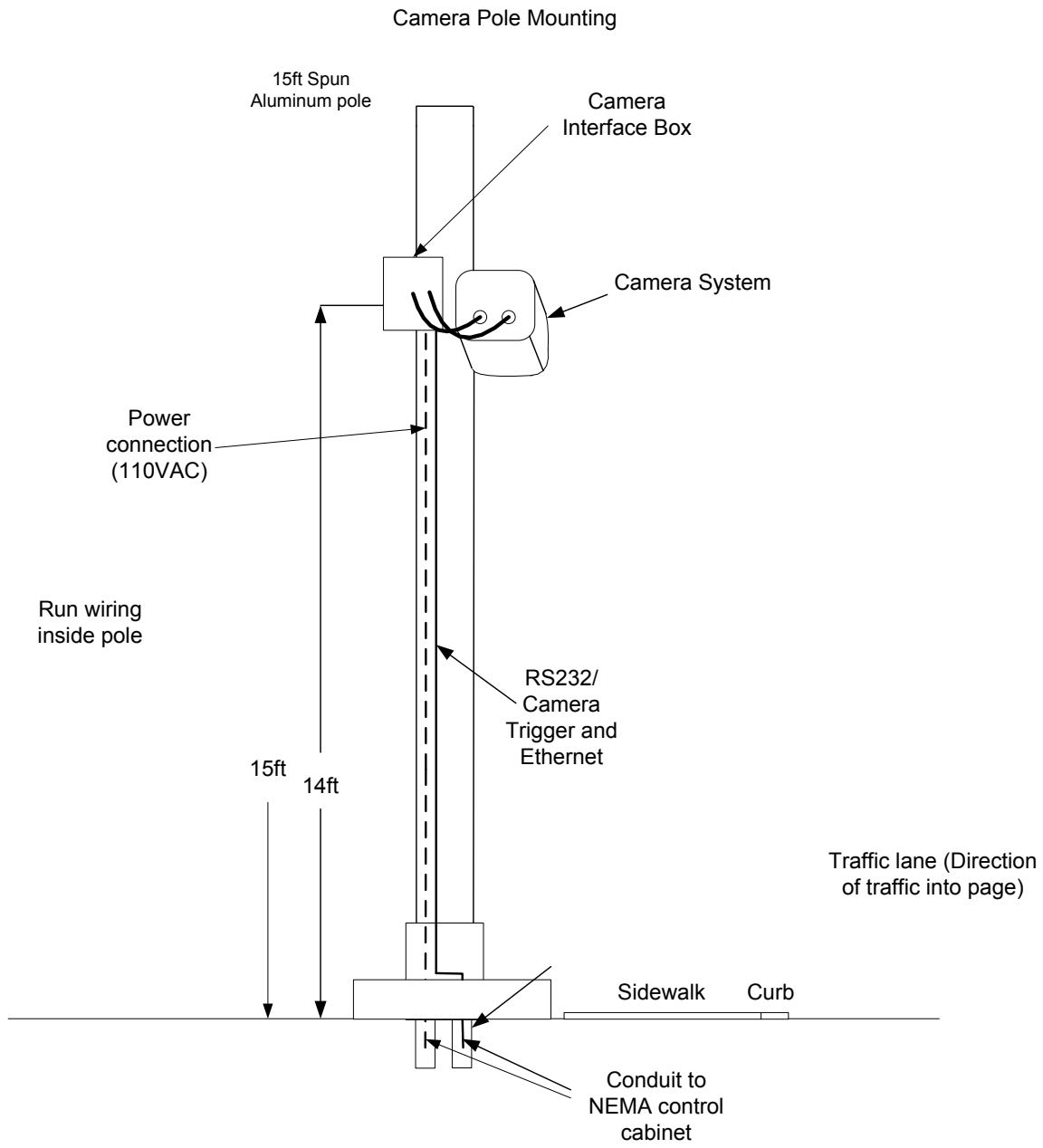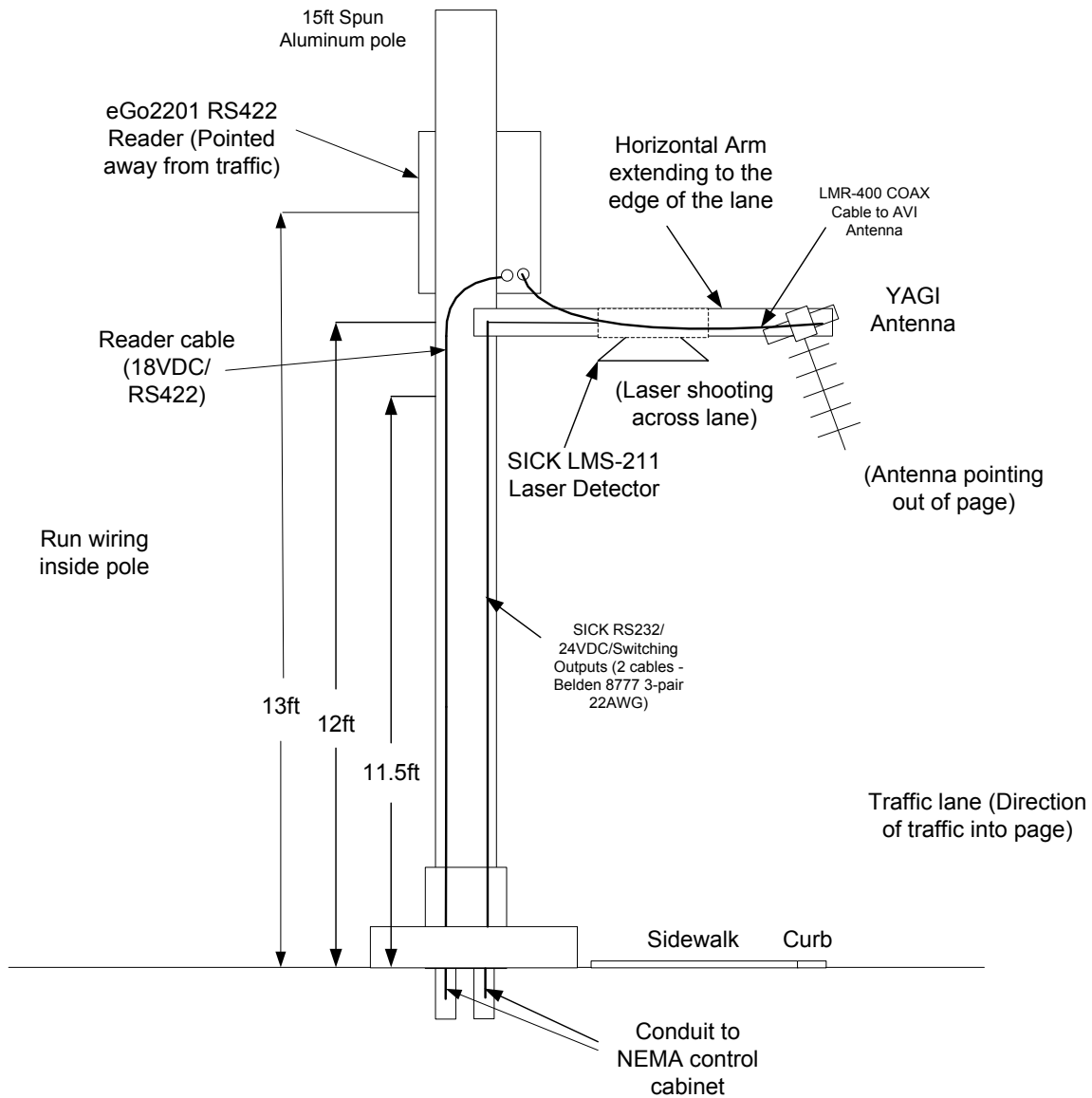
EVR/I Host Equipment

The following equipment is required for operation of the EVR/I Back Office system.

EVR/I Application Server

PowerEdge SC1430: Dual Core Intel® Xeon® 5110; 4MB Cache, 1.6GHz, 1066MHZ
2nd Processor: Ditto above
Memory: 2GB 667MHz (2x1GB), Dual Ranked DIMMs:
Operating System: Windows Server® 2003 R2, Standard Edition with SP2, Includes 5 CALs
Hard Drive Config: Add-in SAS5iR (SATA/SAS Controller) 1-2 Hard Drives-No RAID
Hard Drive Controller: SAS 5IR SAS internal RAID adapter, PCI-Express
Primary Hard Drive: 300GB 10K RPM Serial-Attach SCSI 3Gbps 3.5-in Cabled Hard Drive,
CD/DVD Drive for 2nd Bay: 48X CD-RW/DVD ROM Drive
Network Adapter: On-Board Single Gigabit Network Adapter
Keyboard: Keyboard, USB, Black USBK 1
Mouse: Optical Two-Button Mouse, USB, Black USBOPT
Monitor: No Monitor Option NOMON
System Documentation: Electronic Documentation and OpenManage DVD Kit EDOCS
Hardware Support Services: 1Yr BASIC SUPPORT: 5x10 HW-Only, 5x10 NBD Onsite
International Processing: International Processing

EVR/I Database Server

PowerEdge SC1430: Dual Core Intel® Xeon® 5110; 4MB Cache, 1.6GHz, 1066MHZ
2nd Processor: Dual Core Intel® Xeon® 5110; 4MB Cache, 1.6GHz, 1066MHZ FSB   2PD16
Memory: 2GB 667MHz (2x1GB), Dual Ranked DIMMs:
Operating System: Windows Server® 2003 R2, Standard Edition with SP2, Includes 5 CALs
Hard Drive Configuration: Add-in SAS5iR (SATA/SAS Controller) - RAID 1
Hard Drive Controller: SAS 5IR SAS internal RAID adapter, PCI-Express
Primary Hard Drive: 450GB 15K RPM Serial-Attach SCSI 3Gbps 3.5-in Cabled Hard Drive
2nd Hard Drive: 450GB 15K RPM Serial-Attach SCSI 3Gbps 3.5-in Cabled Hard Drive
CD/DVD Drive for 2nd Bay: 48X CD-RW/DVD ROM Drive
Network Adapter: On-Board Single Gigabit Network Adapter
Keyboard: Keyboard, USB, Black USBK
Mouse: Optical Two-Button Mouse, USB, Black
Monitor: Dell 17 Inch Analog Flat Panel 17LCD 1 [320-5576] 5
Hardware Support Services: 1Yr BASIC SUPPORT: 5x10 HW-Only, 5x10 NBD Onsite
International Processing: International Processing

Shared Storage Backup

PowerVault RD1000
RD1000: RD1000, Ext USB Drive with bundled SW RD1 1   [223-4678]   1
RD1000 Removable Disk Media: Remove Hard Disk Cartridge RD1000, 160GB Native/320GB
Hardware Support Services: 1Yr BASIC SUPPORT: 5x10 HW-Only, 5x10 NBD Onsite
International Processing: International Processing

Network Switch 1 GB -16 Port

PowerConnect 2716: PowerConnect 2716 Web-managed Switch, 16 Port GE
Hardware Support Services: LA 3 Years O/S,PCT,UNY
International Processing: International Processing

EVR/I Workstation

Dell Precision T3400 with 22 inch Flat Screen Monitor
PWS T3400 375W (32bit): Intel™ Core®2 Duo E4600 (2.40GHz/800MHz/2MB L2)
Operating System: Genuine Windows Vista ® Business Downgrade, XP Pro Installed,
Graphic Cards: 256MB PCIe x16 nVidia NVS 290, Dual Monitor DVI Capable
Chassis Configuration and 1394: Mini-Tower Chassis Configuration
Memory: 1GB, 667MHz, DDR2 SDRAM Memory, NECC (2 DIMMS)
CD-ROM, DVD, and Read-Write Devices: 48X/32X CD-RW/DVD Combo Drive
Hard Drive Configuration: C1, All SATA, NO RAID for 1 Hard Drive   SATA1
Boot Hard Drive: 80GB SATA 3.0Gb/s with NCQ and 8MB DataBurst Cache™
Monitor: Dell E228FP, Wide 22 Inch Flat Panel, 22.0 Inch Viewable Image
Resource DVD/CD: Resource DVD - contains Diagnostics and Drivers
Floppy Drive and Media Card Reader Options: No Floppy Drive
Speakers: No Speaker option
Mouse: Dell USB 2-Button Mechanical Mouse with Scroll
Keyboard: USB Entry Quietkey, No Hot Keys
File System: NTFS File System
Hardware Support Services: 3 Year Limited Warranty plus 3 Year NBD On-Site Service
International Processing: International Processing

EVR/I Printer

Dell 2130cn Color Laser Printer
Dell 2130cn Color Laser Printer: Dell 2130cn Color Laser Printer
Cables for Dell Printers: Ethernet Cable, Black - 7 Feet   ETHNET
Hardware Support Services: 1 Year Basic Limited Warranty and 1 Year Advanced
Dell Toner Cartridges: Dell 2130cn 2,500 Page Black Toner Cartridge   BK2500T

Cables and Other Misc. Parts - Host

(10) Cat5 Cables 10Ft
(2) Cat5 Cables 25Ft
(3) 6 outlet Surge Protector, Power supply
(1) IOgear - GCS1732 - 2-Port KVMP Sharing Switch with Cables

EVR/I Host Software

The EVR/I Host Software activates and manages tags, facilitates image management and review management, generates non-compliant notices, tracks and audits each event reported from a lane, performs system monitoring and diagnostics, generates reports and controls system security.

System users are assigned individual user-ids and passwords along with "privileges" to fulfill their specific tasks.

Once a user is provided a user-id and password for system access, that user is permitted access only to specific "authorized" modules of the EVR/I Application from designated workstations on an internal network through a standard browser interface.

EVR/I In-Lane Equipment

FSS will provide MTW one set of detail drawings for each site. The drawings will consist of lane geometry, where poles need to be installed, distance from pole 1 to pole 2, height of poles above the ground, where equipment will be placed on poles. FSS will provide MTW with power and communication specifications needed to operate all equipment at a fixed reader site.

MTW will be responsible for procuring on-island civil engineering services, poles including installation, power equipment and services and communication equipment and services at each of the sites.

Pilot will have 3 fixed lanes consisting of the following equipment and FSS will install the following equipment at each of the fixed reader sites.

DESCRIPTION	PER-SYS
	QTY
Nema (Fixed Lanes)	-
Hoffman Stainless Steel Enclosure (30x24x12)	3
Hoffman Stainless Steel Floor Stand Kit (12x12)	3
McLean T15 Stainless Steel HVAC (120VAC input, 800-900 BTU/Hr.)	3
Alcatel OmniAccess 601 Router - T1 to 10/100 Ethernet	3
WinSystems EPX-C3 Single Board Computer	3
SDRAM and CompactFlash Card	3
enclosure or protective cover for single board computer	3
Powerware 1000VA UPS (120VAC input)	3
Lambda 24VDC/2.1A DIN rail mount supply (SICK / optical input DC supply)	3
Lambda 5VDC/5A DIN rail mount supply (computer / optical output DC supply)	3
Crouzet DIN rail mount input module -- 4-32VDC in / 5VDC out (SICK to computer)	3
DIN rail, Panduit, Entrelec Terminal Block, Router Shelf, Polyphaser	3
Robust Data Comm RS232-422 converters rdc422ic-dv-3p-cc	6
On Pole Items	
SICK Laser Detector/Scanner (Whole System)	3
Vehicle Image Capture Camera	3
Camera Interface Box	3
Camera Bracket	3
eGo2201 AVI Reader (With cable and transformer)	3
AA3100 Yagi Antenna	3

Detailed Component Specifications

RFID Tags

Our solution will make use of a passive, battery-free, tamper-resistant (destruct upon removal) and tamper-evident RFID tag. The RFID tag houses a unique identification code in an Application Specific Integrated Circuit (ASIC). The secure unique identification code is transmitted to the reader/antenna upon activation of the tag on an appropriate radio frequency signal. RFID tags will be installed on vehicles at a predetermined vehicle inspection/registration station.

RFID Tags	Features	Benefits
Read range/speed:	3-5 meters, From 0 to 80 km/h (0 to 50 mph). Unlimited reads.	Vehicles can be monitored at roadway speed without causing congestion.
Security:	Encrypted unique identifier, 64 bits	Provides a secure system with no personal data on the tag.
Security:	Tamper resistance (destroy upon removal)	The tag becomes inoperable if removed from the windshield, preventing transfer of tag from one vehicle to another.
Security:	Tamper evidence	Visual indication of tampering.
Power:	Passive	The tag is battery-free, thin and flexible for low cost and ease of distribution.
Radio Frequency:	915 MHz (902-928 MHz frequency range)	License free band that complies with FCC and Ministry of Telecommunications regulations
Operating temperature:	-40°C to +85°C	Durable long-life.
Environmental (mounted inside the windshield)	Humidity 95% condensing	Works in all weather conditions.

RFID Reader

A RFID reader is an integrated Radio Frequency Identification Device designed for use with an antenna. When combined with an antenna (mounted on a vertical pole on the side of the road), the reader transmits a Radio Frequency (RF) signal that is modulated which stimulates the RFID tag that contains identifying (unique ID number) information. Once the tag is stimulated by the incoming RF signal from the reader the tag reflects the signal and its identification number, back to the reader on a carrier wave using backscatter technology principles. The signal is then decoded to obtain the unique identification number.

Our Fixed Reader infrastructure is deployed to monitor vehicle compliance. The placement of the Fixed Reader Infrastructure (ReadPoints) is determined by (a) **conducting traffic studies and site surveys** or (b) through our conducting a **Business Process and Infrastructure Assessment (BPIA)**, which is a joint process involving local transportation officials, key stakeholders and FSS.

FSS is proposing our Encompass2 (eGo2201) series of AVI readers for the fixed reader sites.

A Handheld Reader consists of a compact computer and compact RFID reader. Handheld units are distributed to the police department or other authorized officials for mobile operations and foot patrols. Tags are read on vehicles at close range with vehicles either being stopped or moving at very slow speeds.

FSS is proposing our Encompass1 eGo/ATA model 751 handheld readers for use in Barbados.

Vehicle Presence (Traffic) Detection System

A Vehicle Presence Detection System enables a vehicle to be "sensed" when it passes a point in the roadway. Examples of various detection technologies include: standard loops, micro-loops, side-fired radar or video motion systems. The detection methodology to be used is dependent upon pre-existing physical infrastructure and the specific geography of each fixed reader location. In an EVR/I system, the presence of a vehicle is detected by the sensor and if an RFID tag read does not occur, then an image is captured of the license plate as the vehicle enters or leaves a vehicle presence detection zone.

FSS proposes the SICK LMS-211 laser measurement system/laser scanner for vehicle presence detection.

Image Capture System

An Image Capturing System consisting of high-resolution cameras utilizing optical character recognition (OCR) software is implemented as part of the EVR/I system. Cameras are mounted on vertical poles on the side of the road. All vehicles entering or exiting a vehicle presence detection system trigger the camera to take multiple images of the rear license plate. Images of the license plates, along with the license plate number, text and type determined by the OCR software in the camera, are sent to a local lane controller or field processing system. The information (image, text, type, etc.) is then sent to the back-office system and processed by a Violation Processing System (VPS), which allows citations to be generated for vehicles that are non-compliant with regulations based on criteria established by the relevant government agency and/or the Courts.

FSS will supply a high-speed integrated camera/processor unit with color and IR overview.

Lane Controller

The Lane Controller computer is the EVR/I "brains" which operates and manages all of the necessary software components that are needed to control the in-lane (roadway) devices and perform all real-time processing of data that is produced by the in-lane devices.

In order to determine which vehicles are noncompliant, the lane controller computers keep a local copy of the Watch List. The lane controller computer receives regularly scheduled updates of the Watch List information.

If a tag identified by a reader is contained in the Watch List, or if a vehicle with no tag is detected, the lane controller computer will work with the in-lane image capture camera to take a picture of the noncompliant vehicle's rear license plate.

Once the lane controller and camera device capture a picture of a non-compliant vehicle's license plate, this picture, along with additional information such as date, time, lane location, etc., are combined in a single vehicle event file that is then transmitted to the EVR/I back-end systems for further processing by the Violation Processing System (VPS).

The EVR/I back-end system provides the tools necessary to allow the system to generate a list of non-compliant vehicles. This list of noncompliant vehicles forms the

EVR/I System "Watch List". The "Watch List" and the "Urgent List" referenced earlier, are used by the in-lane systems to identify non-compliant vehicles.

FSS is proposing the WinSystems EPX-C3 733MHz Single Board Computer for the lane controller computer.

The Watch List and Urgent List

The "Watch List" contains the tag IDs of those vehicles that the system has identified as non-compliant with inspection, registration, insurance, or other regulations. Non-renewal of inspection, registration, or expired insurance data are examples of changes to a vehicle's status that will result in "Watch List" designation for that vehicle. Additionally, the vehicle's status may be changed as a result of inputs from other sources such as an insurance provider signaling that a vehicle's insurance has been prematurely cancelled (possibly due to non-payment of premiums, etc.).

The "Urgent List" contains tag ID's of those vehicles that are associated with a more serious offense and need an officer dispatched immediately. Typically, the Transportable unit is used with the "Urgent List" because officers are already stationed with the Transportable unit. Urgent events, however, are reported by both Fixed and Transportable Reader systems. Special "alert" messages can be sent to Law Enforcement for all relevant Urgent events.

Back-Office Host Software and EVR/I Database System

An accurate EVR/I database is pivotal to a successful EVR/I system implementation. The EVR/I database interfaces with the Government's Driver & Vehicle Registration System and database to obtain the necessary data to determine vehicle compliance with respect to insurance, inspection, registration and/or other regulations.

Our EVR/I system will also interface with separate centralized and/or multiple independent insurance databases. The latter would obtain if appropriate insurance details are not maintained in the government's Driver or Vehicle database. In addition, the EVR/I database list of RFID tag unique identification numbers is the reference key to the complete vehicle identification record, including VIN, license plate number, make, model, year, color, and status.

Additional information can be added to the database if needed. Coupled to the EVR/I databases are lane controllers (consisting of hardware and software components) that store local replicas of the non-compliant RFID tag identification numbers. The lane processing system links captured RFID tag identification numbers from readers and

vehicle images taken with cameras to create transaction records. The record is sent to the back-office system for additional analysis and processing for non-compliant vehicles, otherwise the record is discarded.

Violation Processing System (VPS)

An automatic VPS will normally be implemented with our EVR/I system. The violation processing system is linked with the relevant governmental agency, Law Enforcement, or Court to exchange information for generating and completing citation transactions, including payment processing.

Non-compliant situation examples include but are not limited to the following: a vehicle that has not renewed registration, has not completed safety or emissions inspection testing, does not have insurance, or does not have an RFID Tag installed on the vehicle when it should, or an unauthorized commercial vehicle operating in a restricted zone. All vehicles in such conditions would be identified as violators.

The violation processing system generates citations for the owners of non-compliant vehicles by automatically analyzing OCR images captured at the lanes using predetermined OCR confidence levels generated by the camera. A manual check is used if citations need to be reviewed prior to issuance. Once the vehicle owner and violation are confirmed, the VPS system creates, prints and sends a citation to the vehicle owner. All payments for citations are made through existing government, courts, and registration procedures. Once a fine has been paid and the vehicle is back into compliance the government agency system provides an update to the violation processing system so that the violation can be closed and the vehicle can be taken off the "Watch List".

Violation Processing

Most of the key functions of the host fall into a category we call Violation Processing. Violation processing consists of the following tasks:
- ◆ Human review of Vehicle Event image and data before image and data are processed
- ◆ Load Vehicle Event images and data into VPS database
- ◆ Generation of Non-compliant Notices
- ◆ Watch List and Urgent List Management

Tracking and Audit

Each In-Lane event reported to the Host is assigned a unique sequence number which is stored with the event in the EVR/I Host database. Events that are reviewed or processed are assigned additional tracking numbers either a document number and/or a violation number. At each step in which a decision to accept, reject or update an event is required, the user id, date/time and reason for the decision is recorded by the system. Reports can be run from the system to review decisions made by individual users.

Reports

The VPS solution provides the ability to generate several reports. Reports provided under this proposal include those listed below.

> ➢ Violations by day/hour/site
> ➢ Traffic by day/hour/site
> ➢ Violation history by Tag
> ➢ Owner vehicle information
> ➢ Vehicle status on Watch and Urgent List

Additional specialized reports can be provided.

Transportable Reader System (TRS)

A TRS consists of a tripod or trailer mounted RFID reader, cabling, and a transportable unit, which includes a single board computer, optional LCD display, visual and audible indicators (compliant/non-compliant). The TRS can be powered by either 110 to 240VAC or +12VDC, typical for setting up in a vehicle. The TRS database is updated with the WATCH or URGENT list through either an external USB drive or Ethernet port. The reader transmits a Radio Frequency (RF) signal, which stimulates the vehicle mounted RFID tag containing identifying (unique ID number) information. Once the tag is stimulated by the incoming RF signal from the reader, the tag reflects the signal and its identification number back to the reader.

The resulting signal is then decoded to obtain the unique identification number. This unique identification number is compared to the WATCH and URGENT lists on the TRS computer. If a match is found, the officer is alerted via the audible and visual indicators that the vehicle is non-compliant. Information such as tag id, registered license plate, and reason(s) for non-compliance are displayed on the optional TRS display. The officer can then use a handheld computer or other normal methods to verify owner and vehicle information. FSS is proposing our Encompass2 (eGo2101) series of AVI readers to be used with the transportable reader units.

Section 7 — Why choose FSS' EVR/I Solution?

The Centre for Transport Planning, located in the Faculty of Social Sciences, Cave Hill Campus was established to provide research and technical advisory services to Caribbean governments and private sector entities.

As a regional institution domiciled in Barbados, FSS is committed to effecting pertinent, cutting-edge, efficient and cost effective solutions to address the critical needs of the transportation milieu.

We underscore the fact that our resident skills and capacities to deploy germane and tested ICT solutions constitute a staple that various departments of local government may continue to use.

FSS agrees that (a) the transport sector provides intermediate services – it is not an end in and of itself but means to an end, (b) the sector generally has large capital works components for the building and maintenance of roads and (c) the sector is a major consumer of foreign exchange. We believe that we can bring our expertise to bear on these issues and improve this sector's operations.

Within this context FSS's proposal has focused on:

1. Developing an ICT solution to address transport problems and improve operations.
2. Assessing the existing legal, regulatory and transport policy, recommending improvements and assisting with implementation.
3. Implementing solutions to mitigate the social impact of transport on gender, home and family life. The implemented solutions by extension, shall improve the factors which normally impact negatively on transport and education.
4. Facilitating analysis of a broad range of subjects, e.g. (a) vehicular accidents and (b) the timely generation of data to inform on (alternative) improvements to existing road, street, and highway systems.
5. Facilitating intake mechanisms which provide and inform on the cost-benefit of proposed road safety interventions.
6. Facilitating statistical analysis of vehicle accidents and developing a system which will inform on "real-time" response protocols for consideration by the police service and insurance sector.

FSS is confident that our array of expert knowledge capital and skills will provide the capacity, expertise and cutting-edge technology to permit MTW to achieve an efficient and effective national EVR/I solution.

Our Unique "Additionality"

Our Faculty, in developing this EVR/I proposal for MTW, gave serious consideration to the financial constraints that economies, all over the world, are experiencing.

As an indigenous institution, we are intimately acquainted with fiscal austerity measures that our regional governments must perforce observe. This constraint complexioned our thoughts as we developed this proposal and caused us to propose some tangible "value-added" components to our proposal, elements which we believe are above and beyond the usual provision of "an efficient and cost-effective cutting edge solution".

Inherent in our EVR/I solution lies the "real and present" capacity for MTW's participation in a MTW/FSS collaboration, post your subscription to our EVR/I solution, in our corollary **Virtual EVR/I Back Office services**.

Our **Virtual EVR/I** promotes a transportation management facility replicating our local solution on a fee paid basis for other regional governments. Our **Virtual EVR/I** joint venture would need further discussions, but we believe that in addition to creating employment opportunities for Barbadians in its Customer Support Centre, it has the potential to generate substantive foreign currency through our consortium proffering tailored EVR/I solutions to other regional governments.

The possible revenues will be derived through our **Virtual EVR/I Joint Venture**:

1. Leasing access to EVI/R data/reports/administrative functions e.g. citation issuance, annual registration, tag replenishment, tag equipment matrix of our **Virtual EVR/I facility**
2. Fees levied on client governments in our region would include, but not be limited to (a) use of our EVR/I platform – software and hardware (b) tag cost for annual replenishments and (c) annual compliance/new outfitting/registration fees.
3. Fees levied for our management of the issuance of their jurisdictions' citations for non-compliance. (The caveat for 24/7 operation of the Virtual EVR/I service is that internet connectivity must be guaranteed 24 hours a day)

As such our JV collaboration would see us provisioning "back-end functions" to other regional governments through "dumb" terminals located in specific line agencies in these remote jurisdictions.

Our consortium would also give requisite, fee-based, support and maintenance to MTW/FSS EVR/I equipment in the field.

Section 8	The UWI and the Project Team

The University of the West Indies (UWI) Cave Hill Campus

The University of the West Indies (UWI) is a fully autonomous international institution, which draws most of its students from fourteen countries in the Commonwealth Caribbean – Antigua & Barbuda, Bahamas, Barbados, Belize, British Virgin Islands, Cayman Islands, Dominica, Grenada, Jamaica, Montserrat, St. Kitts/Nevis, St. Lucia, St. Vincent & the Grenadines and Trinidad & Tobago.

The University came into being as the University College of the West Indies under Royal Charter in 1949 at Mona, Jamaica, in special relationship with the University of London. Full university status was achieved on April 2, 1962. Two additional campuses were then established at St. Augustine, Trinidad and Tobago, 1962, incorporating the Imperial College of Tropical Agriculture and at Cave Hill, Barbados in 1963.

The Cave Hill Campus began as the College of Arts and Sciences achieving full-fledged University status as a Campus in 1970, with the establishment of the Faculty of Law. At Cave Hill, ten Departments and four Faculties offer undergraduate and postgraduate programmes in Education, the Humanities, Law, Science and Technology, Clinical Medicine and Social Sciences. The Campus maintains a close relationship with Codrington College, a Theological College founded in 1745, and the Caribbean Meteorology Institute. There are seventeen other affiliated specialist teaching, research and outreach units attached to the Campus. Cave Hill in addition, maintains an active programme of outreach to the community in Barbados, as well as the other islands in the sub-region. Our programmes include hosting annual public lecture series, seminars, workshops, conferences and panel discussions and a range of exciting and educational cultural events.

Cave Hill is well recognised as the centre of intellectual leadership in the Eastern Caribbean. Its positive influence is evident in all sectors of our society, from economic, political, social and business developments, to education, agriculture and health. This track record of service gives testimony to the Campus' unquestioned commitment to the prosperity and development of the Caribbean region.

UWI Cave Hill has a rich mix of experts with specialised technical knowledge, skills and expertise in "real world" problem solving. UWI Cave Hill has the resident capacity to assemble strong, diverse, multi-disciplinary teams, with a range and depth of knowledge and experience of the special issues facing governments, business and industry in Barbados, the Eastern Caribbean, the wider developing world and beyond.

The Campus' track record includes the management of a strong and varied portfolio of training, research and consultancy projects funded and supported by many of our local, regional and international public sector agencies and development institutions.

The UWI Project Team

For this project, the UWI has assembled a team of qualified professionals with the knowledge, skill and experience to successfully achieve the required objectives. The team members are as follows:

- ✓ **Dr. George A. V. Belle, PhD**, Dean, Faculty of Social Sciences
- ✓ **Professor Osaretin Iyare,** Head, Department of Economics
- ✓ **Mr. Wilberne Persaud,** Senior Lecturer, and Coordinator, Banking and Finance Programme, Department of Economics
- ✓ **Dr. Stephen Yearwood,** Lecturer in Economics, Department of Economics
- ✓ **Dr. Justin Robinson,** Lecturer & Head, Department of Management Studies

ICT Sub-Consultants & Service Providers

Transcore is the largest global manufacturer of transportation-based RFID technology with more than 25 million tags and 45,000 readers deployed worldwide in various applications such as electronic toll collection, traffic management, rail, truck, container, barge and intermodal tracking and monitoring, homeland security border control, airport ground transportation, parking and secure vehicle access control.

It has established a 5 year Memorandum of Understanding with the University of the West Indies which expressly seeks to develop specific Electronic Asset Identification /Registration ICT platforms in identified sectors to enhance various transportation management and analysis needs.

Illuminat (Barbados) Ltd. is a leading provider of information technology and communications products, services and solutions. Among its many successful local ICT solutions are **Edutech** and its **Royal Barbados Police Force 911 Emergency Response** national telecommunication solution.

David Weekes & Associates Inc. is an Information Communication and Technology consulting firm. The firm primarily provides **E-Process Re-Engineering** services for varying industries to improve their marketability and market penetration capacities.

Section	Schedule of Costs
9	

Rough Order Magnitude (ROM) Costs

The Faculty of Social Sciences in composing the following **Rough Order Magnitude (ROM)** pricing schedule sought to address the fact that "critical variable information" was unavailable at time of writing this document.

As such our pricing is expected to benefit from clarifications to the assumptions herein submitted. (Also note that ROM prices do not include shipping, duties or local taxes.)
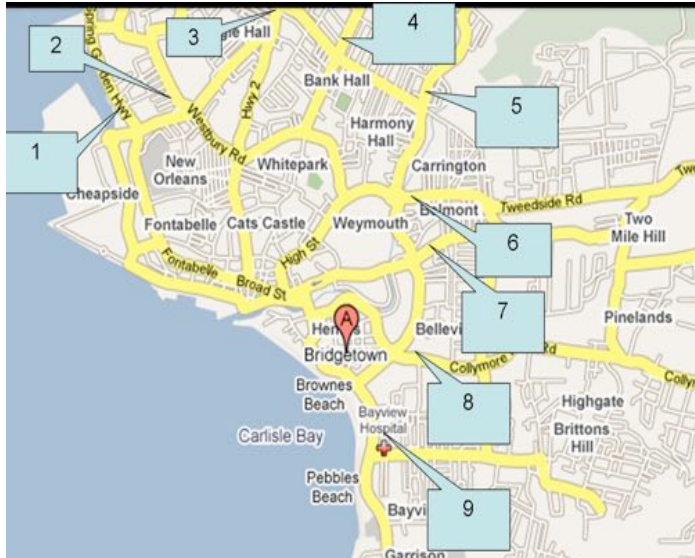
Approximate**, Rough Order of Magnitude (ROM**) pricing follows.

EVR/I for MTW

ROM EVR/I Total:	US$3,888,500

Our Solution will be composed of two "Rings" of our EVR/I equipment matrix positioned at specific waypoints, places where 98% of vehicular traffic MUST pass to (a) enter and/or exit Bridgetown or (b) traverse its major main highways. (N.B. **BPIA confirmations required)**

We will position 9 readers, one at each of the 9 main chokepoints where traffic converges to enter or exit Bridgetown and create our Ring One. (See the map at left)

Points 1 to 9 will have tag readers ONLY.

A 2nd semi-circular ring, **Ring Two** (see below), will be deployed at an "outer-urbis" perimeter. Points 1, 3, 5 6 and 9 of both rings will be outfitted with cameras.

Our proposed 2 ring configuration, (*sine* benefit of our customary **BPIA)**, will comprise 18 tag readers, 9 with cameras, 2 mobile stations, 10 handhelds, 125,000 security tags and commensurate EVR/I Host Software.

(The attendant ROM pricing includes the price of EVR hardware, software, labor, installation support services and travel to support pre-install site survey and system installation. Details regarding each of the above need to be further defined prior to being able to effect local deployment).

Detailed Schedules of Implementation will be

informed by civil works requirements e.g. poles installation, telecommunications matrices, etc., but we project a nine month time-line for full EVR/I implementation and operation.

BPIA Option

BPIA ROM Total:	US$153,500

The BPIA ROM includes labor to support the BPIA process and travel expenses for (3) of our External Technical human resources to travel for (3) 1 week duration trips to Barbados to participate in BPIA meetings. Travel is from Dallas, Texas to Barbados. It is anticipated that the BPIA process would be conducted over a 60 calendar day time period.

Section 10

Payment Schedule & Options

Payment Schedule

The following payment schedule is proposed:

- 25% mobilisation fee on approval and contractual acceptance of our proposal
- 10% interim payments (post submission of our invoice every 30 days) until a maximum of 85% is received by FSS
- 15% remainder, 60 days after completion, and commissioning, of the EVR/I

FSS' Build.Operate.Lease.Transfer (BOLT) Alternative

We propose offering MTW a **Build, Operate, Lease and Transfer** proposal for this EVR/I. This suggestion/option finds its genesis in FSS' commitment to provide meaningful services and consultancies to our constituent governments.

The University, as part of our strategic plan, 2007 – 2012, among other imperatives, charged its respective institutes, faculties and departments to (a) develop revenue streams to meet operational costs and (b) develop sustainable "Centres of Excellence" while leveraging the resident pool of experienced knowledge workers and capacities of our staff.

We consider it both an honour and a distinct privilege to be able to proffer our services to MTW to meet your needs. It is therefore incumbent upon us, to keep faith with "our constituencies", and to propose workable financing options for active consideration.

B.O.L.T is actually not a new concept for funding the acquisition of any asset. The Panama Canal, various turnpikes in the USA and several other significant government works projects across the world have all been funded by these means. FSS would therefore wish that, should the inclusive proposal find your favour and that MTW is desirous of discussing how project financing might thereafter ensue, we could meet to discuss funding this EVR/I proposal through use of our B.O.L.T modality.

We believe that we are offering MTW a feasible option to acquire ALL the EVR/I needs. In this way, a critical infrastructural requirement—managed transport registration and identification—can be financed without immediate public capital funding through yet-to-be agreed revenue sharing allocated from operating revenues over a mutually agreeable contract period.

Generic variations of the B.O.L.T. theme are provided below:

Build-Transfer-Operate	Build-Own-Operate	Build-Transfer-Operate	Build-Lease-Transfer
The contract will specify the upgrade and operation of the enterprise by the concessionaire for a fixed period of time followed by the transfer of all facilities and equipment back to the owner.	The concessionaire is essentially buying the basic facility in installments from the owner, with the facility and it's upgrades provided as security over the repayment period. On completion of the contract, ownership reverts to the concessionaire.	The concessionaire builds and transfers a facility to the owner but exclusively operates the facility on behalf of the owner by means of a management contract.	The concessionaire builds a facility, leases out the operating portion of the contract, and on completion of the contract, returns the facility to the owner.

Section 11 — Anticipated Outcomes

The major deliverable of our EVR/I solution will be installation of a cutting edge technological solution enabling MTW to deliver efficient and effective national Electronic Vehicle Registration and Identification

The list of the uses of our EVR/I is extensive. We seek here to enumerate merely a few of its unique benefits:

- ✓ Support MTW's various regulatory functions e.g. traffic probes for monitoring / analyzing traffic and "feeding" traffic management systems to improve traffic flows, reduce congestion, inform on road usage and MTW road construction and maintenance activities.
- ✓ Support Compliance Monitoring of commercial and private vehicles – to ensure they are safe (have passed required safety inspections), have paid MTW road tax, are appropriately insured and, for the specific sub grouping of PSVs, that they are operating on authorized routes.
- ✓ Support policing – Compliance monitoring for speed enforcement, compliance monitoring for unpaid traffic violations.
- ✓ Facilitate Research in Social and Economic issues on a broad range of topics e.g. vehicular accidents, impact of health care for accident victims with no vehicular insurance, traffic management, alternative ground transportation etc.
- ✓ Inform on the organizational framework for a Traffic Accident Response Service and National Disaster Traffic Management programme.
- ✓ Create new and previously untapped or non-optimized revenue streams.

UWI/FSS is committed to providing direct support to Caribbean governments and private sectors through research and project management solutions.

We hope that our EVR/I proposal using the expertise of our HR pool will give MTW real options to streamline/optimize the local transport matrix, while providing you the opportunity to generate alternative and in cases, entirely new revenue streams.