<u>System Design Document</u>

Linking of Kiple's License Plate Recognition engine to Sigmatech's Maxpark Parking System.

V1.0

Early November 2018

Revision History

#	Version	Description	By	Date
1.	V0.1	Preliminary Design Document	TSL	24 Oct 2018
2.	V0.1A	Additional "LS" Message added	TSL	31 Oct 2018
3.	V1.0	Modified "LD" Message	TSL	09 Nov 2018

License Plate Recognition (LPR) System for Maxpark.

1.   Overview
1.1   The purpose of this project is to integrate Kiple's License Plate Recognition (LPR) Engine
        into the Maxpark Parking system.
1.2   An LPR engine will be installed in a camera at each entry and exit station. This engine will
        be able to determine a vehicles' License Plate and transmit it to the Maxpark parking
        system via the LPR Local Agent (LPRLA)
1.3   This system will work alongside the standard Maxpark ticket dispensers to allow Customers
        whose vehicle's License Plate cannot be recognized by the LPR Engine, to enter the
        parking site as well.
1.4   This module is also expected to work alongside the "Online System Payment" module and
        the "QR App" module to allow the Customers to receive e-Tickets and make e-payments.
1.5   The system structure shall be as the figure below
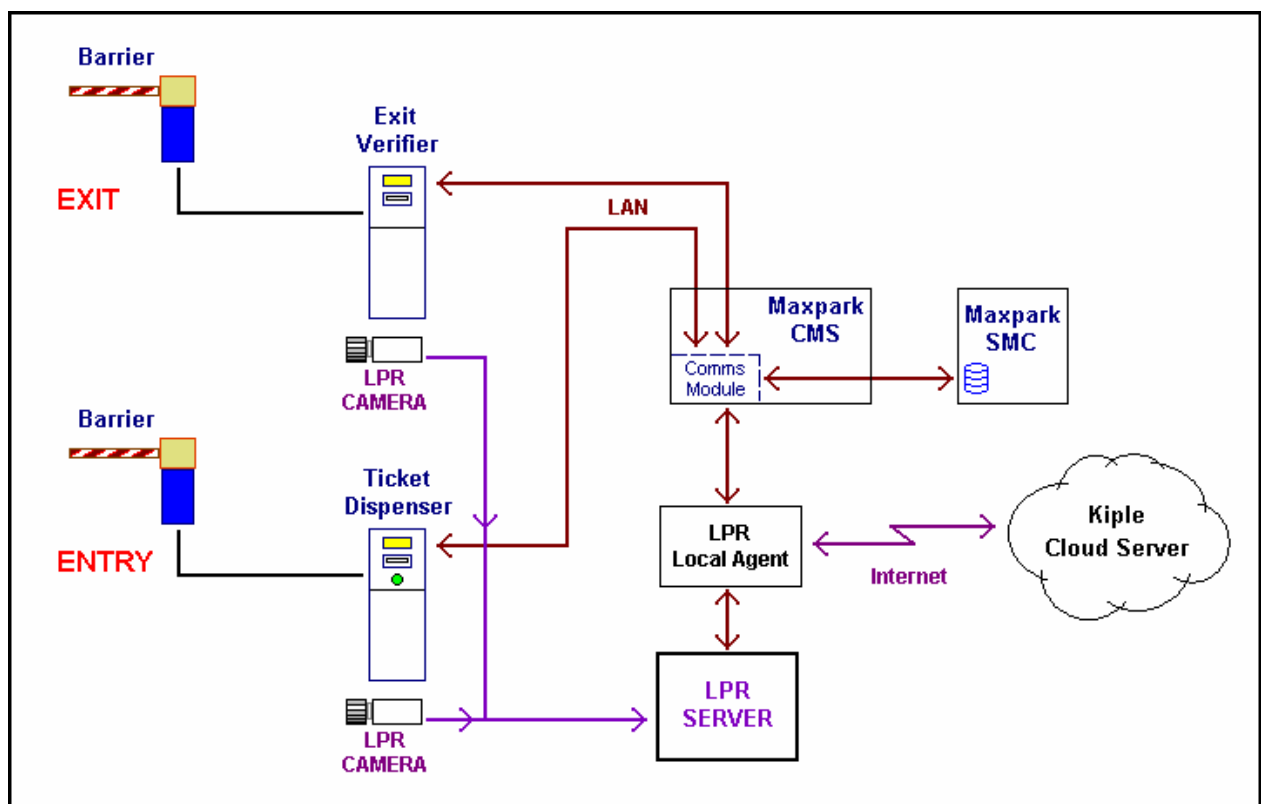

Fig 1.1 Expected equipment configuration and connection for the System.

1.5.1   LPR Camera   – This is an IP Camera that contains an LPR Engine. One will be installed at each entry and exit lane of the Parking site. It will determine a vehicle's License Plate and transmit it to the LPR Server.

1.5.2   Kiple Cloud Server   – This is a server in the cloud that will perform e-Ticket handling as well as perform online payments

1.5.3   LPR Local Agent – This is program installed on an internet enabled PC and will be installed at site. It will act as the bridge between the Kiple Cloud Server, the LPR Server and the Maxpark CMS Parking Server.

1.5.4   Comms Module – This is an additional module in the Maxpark CMS Server that will communicate with the LPR Local Agent (LPRLA). It will also link with Maxpark's SMC to handle Season Pass functions.

1.5.5   Maxpark CMS – Maxpark's Standard Parking Server.

1.5.6   Maxpark SMC – Maxpark's Standard Season Pass Server.

1.5.7   Ticket Dispensers, Exit Verifiers, Barriers are standard parking equipment to control entry and exit from a parking site.

1.6   Comms Module, Ticket Dispenser, Exit Verifier, Barriers and all other necessary sensors and relays required to raise and lower the Barrier shall be by Sigmatech.

1.7   LPR Camera's, LPR Local Agent, LPR Server, Cloud Server and any site internet connections shall be by others.

1.8   Notes

1.8.1   It is expected that the first phase of the implementation shall be using LPR for Season Pass users ONLY. Subsequent phases will integrate walk in customers as well.

1.8.2   It is expected that the Recognition Rate for the LPR system shall be greater than 99% to be viable. Current recognition rate is 96% for all legal plates, but Kiple have indicated that it can rise to over 99% as the Camera "Learns".

1.8.3   The "Online System Payment" module will be as specified in the document *"Online Payment System Link to Maxpark CMS V1.00 Rev.D"*

1.8.4   The e-Ticket handling module shall be as specified in the document "*Linking of Sigmatech's QR Code Reader to Kiple's QR App. V1.0 Rev A***"**

1.8.5   It is expected that there will be a central pay counter for any site that uses this LPR system. This is to allow the Users to handle any unforeseen conditions.

2.   Standard System Operation

2.1   Season Only Entry Operation.
2.1.1   Driver will approach Entry gate.
2.1.2   LPR Camera (LPRC) will determine vehicle License Plate and send it to the LPRLA via the LPR Server
2.1.3   LPRLA will determine if the License Plate belongs to a registered Kiple e-purse holder and send the information to the Comms Module.
2.1.4   The Comms Module will determine if the Vehicle is a registered season pass holder.
2.1.4a If No, the Comms Module will send a message to the appropriate Ticket Dispenser (TD) to enable the Ticket Button so that the Driver can take a physical ticket.
2.1.4b If Yes, the Comms Module will send a message to the appropriate TD to raise the barrier and mark it as a season transaction.
2.1.5   After the Driver passes the Barrier, the TD will lower the barrier and the system will reset.

2.1.6   Notes
2.1.6.1a   When the TD detects a vehicle, it will NOT enable the Ticket Button, but will wait for a set time (2-5 seconds) for any message from the Comms Module while displaying the message "Waiting for LPR"
2.1.6.1b   If no message is received during the set time, it will enable the Ticket Button.

2.2   Season Only Exit Operation.
2.2.1   Driver will approach Exit gate.
2.2.2   LPR Camera (LPRC) will determine vehicle License Plate and send it to the LPRLA via the LPR Server
2.2.3   LPRLA sends the License Plate to the Comms Module.
2.2.4   The Comms Module will determine if the Vehicle is a registered season pass holder.
2.2.4b If Yes, the Comms Module will send a message to the appropriate Exit Verifier (EV) to raise the barrier and mark it as a season transaction.
2.2.5   After the Driver passes the Barrier, the EV will lower the barrier and the system will reset.

2.3   Standard Entry Operation. (Future)

2.3.1   Driver will approach Entry gate.

2.3.2   LPR Camera (LPRC) will determine vehicle License Plate and send it to the LPRLA via the LPR Server

2.3.3   LPRLA will determine if the License Plate belongs to a registered Kiple e-purse holder and send the information to the Comms Module.

2.3.4   The Comms Module will determine if the Vehicle is a registered season pass holder.

2.3.4a If Yes, the Comms Module will send a message to the appropriate TD to raise the barrier and mark it as a season transaction.

2.3.4b If No, the Comms Module will generate an e-Ticket and send a message to the appropriate TD to raise the barrier and mark it as an LPR transaction.

2.3.4b.1   In addition, if the vehicle also has a registered Kiple e-purse, then the Comms Module will send the e-Ticket to the Kiple Cloud Server as per the document, "Linking of Sigmatech's QR Code Reader to Kiple's QR App. V1.0 Rev A"

2.3.5   After the Driver passes the Barrier, the TD will lower the barrier and the system will reset.

2.3.6   Notes

2.3.6.1a   When the TD detects a vehicle, it will NOT enable the Ticket Button, but will wait for a set time (2-5 seconds) for any message from the Comms Module while displaying the message "Waiting for LPR"

2.3.6.1b   If no message is received during the set time, it will enable the Ticket Button.

2.4   Standard APM Payment Operation. (Future)

2.4.1   Standard Maxpark Autopay Machine (APM) will be modified to have a Driver interface to allow Driver's to key in their License Plate.

2.4.2   If Driver took a physical ticket, then payment can proceed as per normal operation.

2.4.3   If Driver did not take a physical ticket, then the Driver will have to key in their Car License Plate.

2.4.4   The APM will then search for a match in the CMS database.

2.4.4.1   If match is found, the APM will calculate fare and payment can proceed as per normal operation.

2.4.4.2   If a match is not found, the APM will display a list of alternates for the Driver to choose.

2.4.4.3   If the vehicle number is in the list of alternates, then the Driver will select the appropriate License Plate and payment can proceed as per normal operation.

2.4.4.4   If the plate is NOT found in the list of alternates, the APM will direct the Driver to make payment at the central pay station.

2.5   Other Payment Option (Future)

2.5.1   If the Driver has a physical ticket and has a Kiple e-wallet, then the Driver can use the Kiple app to scan the ticket and payment can proceed as specified in the document *"Online Payment System Link to Maxpark CMS V1.00 Rev.D"*

2.5.2   If the Driver does not have a physical ticket but has a Kiple e-wallet, then the Driver can use the Kiple app to make payment as specified in the document "*Linking of Sigmatech's QR Code Reader to Kiple's QR App. V1.0 Rev A*"

3.   LPR Local Agent – Comms Module Communications Link.
3.1   Communications between the LPRLA and the Comms Module shall be by IP messaging.
3.2   It is expected that the LPRLA will act as a client, while the Comms Module will act as a server.
3.3   One or two dedicated ports shall be used for communications.
3.3.1 IP Port number used for communications will be **4710**.
3.3.2 Additional Ports (if required) can be determined at a later date.
3.4   It is expected that if the communications port fails, the LPRLA shall automatically try to re-establish the communications link.

3.5   Standard Message Structure for communications shall be as follows

3.5.1 STX | CMD | DATA | CHECKSUM | ETX

3.5.1a STX   = Fixed byte   = 0x02
3.5.1b ETX   = Fixed byte   = 0x03
3.5.1c CHECKSUM = 1 byte
                   = xor of CMD and all DATA bytes.
                   If value is less than 0x20 then add 0x20
                   Eg If xor of CMD and DATA results in 0x0A then CHECKSUM = 0x2A

4.   Commands Summary

4.1   LPRLA to Comms Module Commands
4.1.1 The following commands may be sent from the LPRLA to the Comms Module.

4.1.2 License Plate Detected Message (Command "LD") – This tells the Comms Module that a Vehicle License Plate has been detected.

4.2   Comms Module to LPRLA Commands
4.2.1 The following commands may be sent from the Comms Module to the LPRLA.

4.2.2 License Plate Status Message (Command "LS") – This tells the LPRA how a previously received Vehicle License Plate will be treated.

5.   Command Details

5.1   License Plate Detected Message (Command "LD")
5.1.1   This message is sent by the LPR Server to the Comms Module when a vehicle license plate is detected trying to enter or leave the parking site.

5.1.2   DATA = CAMNUM + PLATE + SIZE + PUBLISHER
5.1.2a CAMNUM (4 Chars)   = LPR Camera that detected the Vehicle License Plate. If less than 4 characters, it should be left padded with spaces.
5.1.2b PLATE (16 Chars)   = License Plate of vehicle. If less than 16 characters, it should be left padded with spaces.
5.1.2c SIZE (3 Digits)   = Size of the Publisher data to follow. This is only used if the vehicle is also registered as a QR App user. If set to "000" then it is assumed that the vehicle is not a QR App registered user. If the value is less than 3 digits then it should be left padded with "0"'s
5.1.2d PUBLISHER (10 Chars)   = Publisher of the QR App. Omit if vehicle does not have a registered QR App.

5.1.3a Command example 1
        STX | "LD" | "N001" | "   WAX1234" | "000" | 0x3D | ETX
5.1.3a.1   This means License Plate WAX1234 was read from Camera N001. Vehicle does not have a registered QR App.
5.1.3b Command example 2
        STX | "LD" | "X001" | "   BCW5678" | "010" | "KiplePark@" | 0x39 | ETX
5.1.3b.1   This means License Plate BCW5678 was read from Camera X001. Vehicle is a registered QR App user from Publisher "KiplePark@".

5.1.4   When the Comms Module receives this message, it will check if the vehicle is a registered season pass user and send the appropriate message to the TD/EV.

5.1.5   Picture Transfer
5.1.5.1   It is expected that whenever the LPRLA sends this message, it will also send a picture of the vehicle as well.
5.1.5.2   The picture can be downloaded to a fixed shared folder on the Comms Module PC.
5.1.5.3   The picture filename will have the format, yyyymmddccccxxxxxxxxxxxxxxxx, where
5.1.5.3a   yyyymmdd   = Date of file.
5.1.5.3b   cccc   = Camera ID
5.1.5.3c   xxxxxxxxxxxxxxxx   = License plate number.
5.1.5.4   Exact location of the shared folder to be determined at a later date.

5.1.6   Notes
5.1.6a It is expected that the LPRLA will strip away any spaces in the License Plate (PLATE). (eg LPRLA will send "Putrajaya1234" instead of "Putrajaya 1234")
5.1.6b It is expected that the picture file sent by the LPRLA will be in .jpg or .gif format.
5.1.6c It is expected that the picture file is sent before the "LD" message is transmitted.

5.2 License Plate Status Message (Command "LS")

5.2.1 This message is sent by the Comms Module to the LPRA in reply to an "LD" message, to inform it how the License Plate will be treated.

5.2.2 DATA = CAMNUM + PLATE + STATUS + SIZE + PUBLISHER

5.2.2a CAMNUM (4 Chars) = LPR Camera that detected the Vehicle License Plate. This will be the same as in the received "LD" message.

5.2.2b PLATE (16 Chars) = License Plate of vehicle. This will be the same as in the received "LD" message.

5.2.2c STATUS (10 Chars) = Status of the License Plate. This will have the following meaning:

5.2.2c.1 SN00000000 = Season Entry OK

5.2.2c.2 SX00000000 = Season Exit OK

5.2.2c.3 SA00000000 = Season, Anti Passback Error

5.2.2c.4 SE00000000 = Season, Expired Registration Error

5.2.2c.5 SB00000000 = Season, Blacklisted Registration Error

5.2.2c.6 TKxxxxxxxx = Non Season vehicle. xxxxxxxx will be the Ticket Number

5.2.2d SIZE (3 Digits) = Size of the Publisher data to follow. This is only used if the vehicle is also registered as a QR App user. If set to "000" then it is assumed that the vehicle is not a QR App registered user. If the value is less than 3 digits then it should be left padded with "0"'s

5.2.2e PUBLISHER (10 Chars) = Publisher of the QR App. Omit if vehicle does not have a registered QR App.

5.2.3a Command example 1

STX | "LS" | "N001" | "   WAX1234" | "SE00000000" | "000" | 0x27 | ETX

5.2.3a.1 This means License Plate WAX1234 was read from Camera N001. Vehicle will allowed entry as a Registered Season User, but does not have a registered QR App.

5.2.6 Notes

5.2.6a Currently no notes.