**<u>System Design Document</u>**


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

V1.1

Late April 2019

**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 |
| 4 | V1.0A | Modified "LS" Message. Modified "LD" Message. | TSL | 26 Feb 2019 |
| 5 | V1.1 | Modified "LS" message to handle new Duplicate Ticket procedure. Added new command "MD" to allow LPRLA to manually open the exit barrier. | TSL | 25 Apr 2019 |
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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.
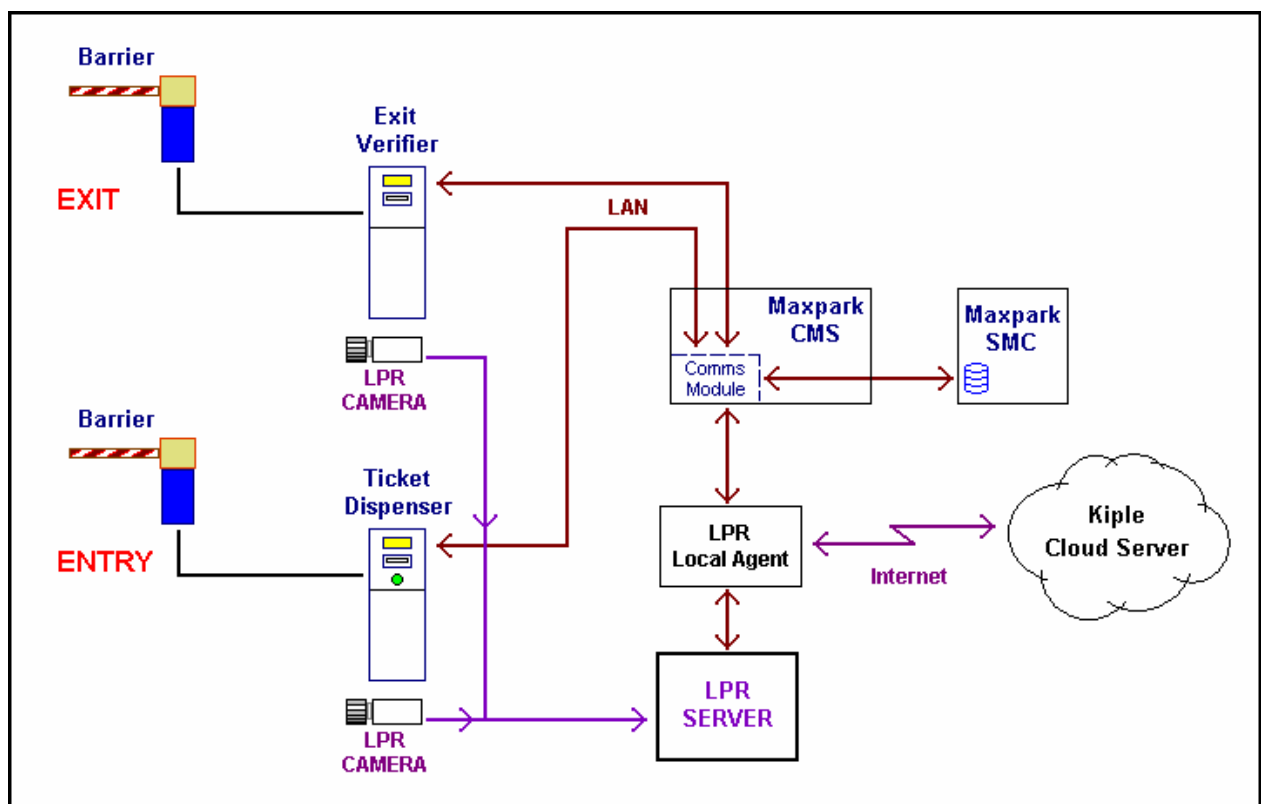1.5     The system structure shall be as the figure below



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.

4.1.3 Manual License Plate Message (Command "MP") – This tells the Comms Module that a Manual Vehicle License Plate has been entered and it should raise the barrier. (For Exit only)


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.

4.2.3 Manual License Plate Status Message (Command "MS") – This tells the LPRA how a previously received Manual License Plate Message 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.
5.1.5.5        Filename may be modified to suit Site conditions.

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.
5.1.6d  Special "SIZE" number "999" during Entry.
5.1.6d.1        If the "SIZE" field is set to "999" during entry, it means that the LPR is unable to detect the Plate # or there is some error during processing.
5.1.6d.2        In this case the BTD will require the Driver to press for a physical ticket.
5.1.6d.3        When the SIZE is set to "999", the PUBLISHER field is omitted

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
5.2.2c.7        TUxxxxxxxx   = Non Season vehicle. Ticket not Paid Error. (Exit Only)
5.2.2c.8        TGxxxxxxxx   = Non Season vehicle. Exceeded Grace Period Error. (Exit Only)
5.2.2c.9        TCxxxxxxxx   = Non Season vehicle. Ticket already used Error. (Exit Only)
5.2.2c.10       TXxxxxxxxx   = Non Season vehicle. Other Error. (Exit and Entry)
5.2.2c.11       TD00000000   = Non Season vehicle. Duplicate Plate. (Entry Only)

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.


5.2.4   Special Payment Details Data
5.2.4.1 Maxpark may be configured to send Payment details to the LPRA upon successful exit.
5.2.4.2 In this case the "SIZE" field will contain the size of the data to follow and the PUBLISHER field will contain the payment data.
5.2.4.3 Payment Data will be in the format: RECEIPT + VALUE + GST + PDATE + PAYLOC
5.2.4.3a        RECEIPT  (12 Chars)
                = Receipt Number for the Payment.
5.2.4.3b        VALUE (6 Chars)
                = Parking Fee for the ticket in sen (ie Payment Value)
5.2.4.3c        GST (4 Chars)
                = GST value calculated by parking system (included in VALUE).
5.2.4.3d        PDATE (12 Chars)
                = Date / Time of payment in format: "YYYYMMDDHHNN"
5.2.4.3e        PAYLOC (10 Chars)
                Location where payment was made

## 5.2.6   Notes

5.2.6.1 If Maxpark detects a duplicate License Plate, it will do the following

| | |
|---|---|
| 5.2.6.1a | If previous entry ticket has been paid, it will mark it as exited with exit time = current time. |
| 5.2.6.1b | If previous entry ticket was not paid, then it will mark it as cancelled. |
| 5.2.6.1c | In both the above cases, the action will be stored in Maxpark as an exception. |
| 5.2.6.1d | Once all previous entry records have been processed, Maxpark will generate a new ticket and the system can proceed as normal. |

5.3     Manual License Plate Message (Command "MP")

5.3.1   This message is sent by the LPR Server to the Comms Module to indicate that there was a recognition error in the LPR system and an operator has manually authorized the Parking System to open the Barrier to let the vehicle through.

5.3.2   This command is applicable to Exit stations only.

5.3.3   When Maxpark receives this message, it will search for the corrected plate #

5.3.3a  If Found and

5.3.3a.1        Ticket Paid -   Proceed as normal

5.3.3a.2        Ticket NOT Paid – Mark as a Cancelled ticket.

5.3.3a.3        Ticket Paid but exceeded exit grace period – Mark as Exited but generate an exception.

5.3.3a.4        Ticket NOT Found – Generate an exception

5.3.4   In all cases, Maxpark will open the relevant barrier after processing to let the vehicle through.


5.3.5   DATA = CAMNUM + PLATE + SIZE + PUBLISHER

5.3.5a  CAMNUM (4 Chars)           = LPR Camera that detected the original Vehicle License Plate. If less than 4 characters, it should be left padded with spaces.

5.3.5b  PLATE (16 Chars)           = Manually entered License Plate of vehicle. If less than 16 characters, it should be left padded with spaces.

5.3.5c  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

5.3.5d  PUBLISHER (10 Chars)       = Publisher of the QR App. Omit if vehicle does not have a registered QR App.


5.3.6a  Command example 1
        STX | "MP" | "X001" | "        WA1234K" | "000" | 0x3D | ETX

5.3.6a.1        This means License Plate WA1234K was manually entered from a License Plate originally detected from Camera N001. Vehicle does not have a registered QR App.

5.3.6b  Command example 2
        STX | "MD" | "N001" | "        BDD5678" | "010" | "KiplePark@" | 0x2E | ETX

5.3.6b.1        This means the License Plate BCW5678 was manually entered from a License Plate originally detected from Camera N001. Vehicle is a registered QR App user from Publisher "KiplePark@".


5.3.7   Picture Transfer

5.3.7.1         It is expected that whenever the LPRLA sends this message, it will also send a picture of the vehicle as well.

5.3.7.2         The picture can be downloaded to a fixed shared folder on the Comms Module PC.

5.3.7.3         The picture filename will have the format, yyyymmddccccxxxxxxxxxxxxxxxx, where

5.3.7.3a        yyyymmdd               = Date of file.

5.3.7.3b        cccc                   = Camera ID

5.3.7.3c        xxxxxxxxxxxxxxxx       = License plate number.

5.3.7.4         Exact location of the shared folder to be determined at a later date.

5.3.7.5         Filename may be modified to suit Site conditions.


5.3.8   Notes

5.3.8.1 This command only works if a vehicle is detected at the appropriate exit station.

5.4    Manual License Plate Status Message (Command "MS")
5.4.1  This message is sent by the Comms Module to the LPRA in reply to a previous "MP" message, to inform it how the License Plate was treated.

5.4.2   DATA = CAMNUM + PLATE + STATUS + SIZE + PAYMENT
5.4.2a CAMNUM (4 Chars)    = LPR Camera that detected the Vehicle License Plate. This will be the same as in the received "MP" message.
5.4.2b PLATE (16 Chars)    = License Plate of vehicle. This will be the same as in the received "MP" message.
5.4.2c STATUS (10 Chars)   = Status of the License Plate. This will have the following meaning:
5.4.2c.1      TZ00000000   = Command Rejected – No vehicle detected. Barrier is NOT raised
5.4.2c.2      TKxxxxxxxx   = Paid and within Grace Period. xxxxxxxx will be the Ticket Number
5.4.2c.3      TFxxxxxxxx   = Ticket not Found.
5.4.2c.4      TUxxxxxxxx   = Ticket not Paid.
5.4.2c.5      TGxxxxxxxx   = Exceeded Grace Period..
5.4.2c.6      TCxxxxxxxx   = Ticket already used.
5.4.2c.7      TXxxxxxxxx   = Other Error.

5.4.2d SIZE (3 Digits)       = Size of the PAYMENT data to follow. If set to "000" it means that no payment data was found.
5.4.2e PAYMENT (44 Chars)       = Payment details (If any). This will have the following format:
5.4.2e.1      RECEIPT + VALUE + GST + PDATE + PAYLOC
5.4.2e.1a     RECEIPT  (12 Chars)
              = Receipt Number for the Payment.
5.4.2e.1b     VALUE (6 Chars)
              = Parking Fee for the ticket in sen (ie Payment Value)
5.4.2e.1c     GST (4 Chars)
              = GST value calculated by parking system (included in VALUE).
5.4.2e.1d     PDATE (12 Chars)
              = Date / Time of payment in format: "YYYYMMDDHHNN"
5.4.2e.1e     PAYLOC (10 Chars)
              Location where payment was made

5.4.3a Command example 1
       STX | "MS" | "X002" | "      WAX1234" | "TU34567890" | "000" | 0x2D | ETX
5.4.3a.1      This means the Manual License Plate WAX1234 was read from Camera X002 location. Vehicle will be allowed to exit even though associated ticket is unpaid.
5.4.3a Command example 2
       STX | "MS" | "X001" | "      WBY1234" | "TK12345678" | "044" | "RS8100001234" | "000500" | "0000" | "201901011533" | "   APM100" | 0x52 | ETX

5.4.4   Notes
5.4.4.1 Currently there are no notes.