

## **A1.6 Toll Collection**

### **1) Service Requirements and Use Cases**

#### **(1) 1st Stage**

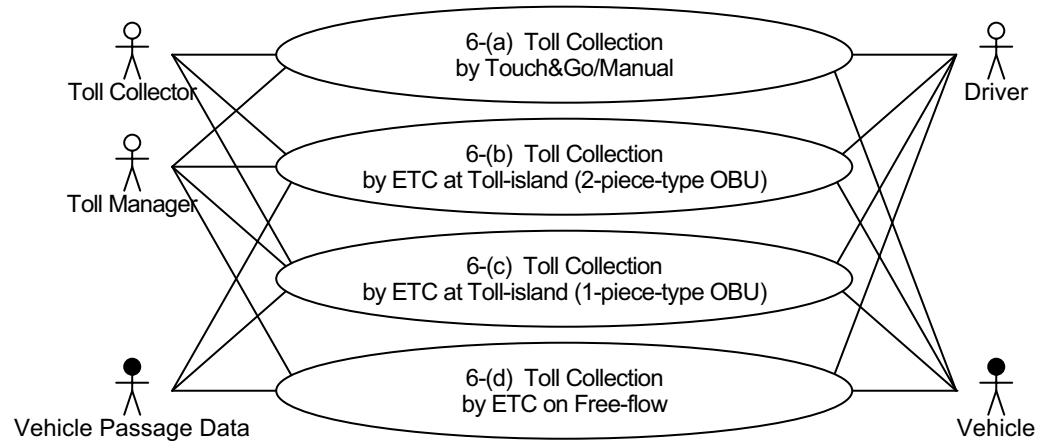
- (i) Non-stop toll collection responding to the distance-proportional/sectional/flat tariff system,
- (ii) Capability of combined use of non-stop toll collection and one-stop toll collection for efficient implementation of roadside equipment: in-coming by non-stop and out-going by one-stop, and in-coming by one-stop and out-going by non-stop as well,
- (iii) Average service-time less than 4.5sec/vehicle by non-stop toll collection such as ETC,
- (iv) Average service-time less than 6.0sec/vehicle by one-stop toll collection such as Touch&Go,
- (v) Toll payment by prepayment,
- (vi) Capability of checking sufficiency/shortage of prepaid balance by the driver in advance or en-route using OBU and contact-less IC-card: balance-in-card,
- (vii) Shared use of OBU among different road sections under the different road operators for convenience of the user,
- (viii) Achieving a low error ratio (less than 0.01%) of treating the short prepaid balance as sufficient, and the sufficient prepaid balance as short,
- (ix) Achieving a low error ratio (less than 0.01%) of falling into inoperable situation by system errors, and easy procedure to recover the system errors,
- (x) Conformance to the vehicle classification defined by the Vietnamese Government,
- (xi) Identifying vehicle class without costly detectors, and easy system modification for revision of the vehicle classification,
- (xii) Capability of sure prevention of unlawful passage including violation,
- (xiii) Simple roadside equipment component for non-stop/one-stop toll collection to be connected to existing system for manual toll collection by the stepwise implementation.

#### **(2) 3rd Stage**

- (i) Shared use of OBU and contact-less IC-card with ERP (Electronic Road Pricing) in the urban area.

The following four alternative use cases are to be considered in the discussion.

**Figure A1.6.1 Use Case Diagram of Toll Collection**



Source: VITRANSS 2 Study Team

## 2) Message Sequence Diagram

The message sequence diagram (MSD) of the use cases above are shown in the following pages.

Figure A1.6-(a).MSD Toll Collection by Touch&Go/Manual (1)

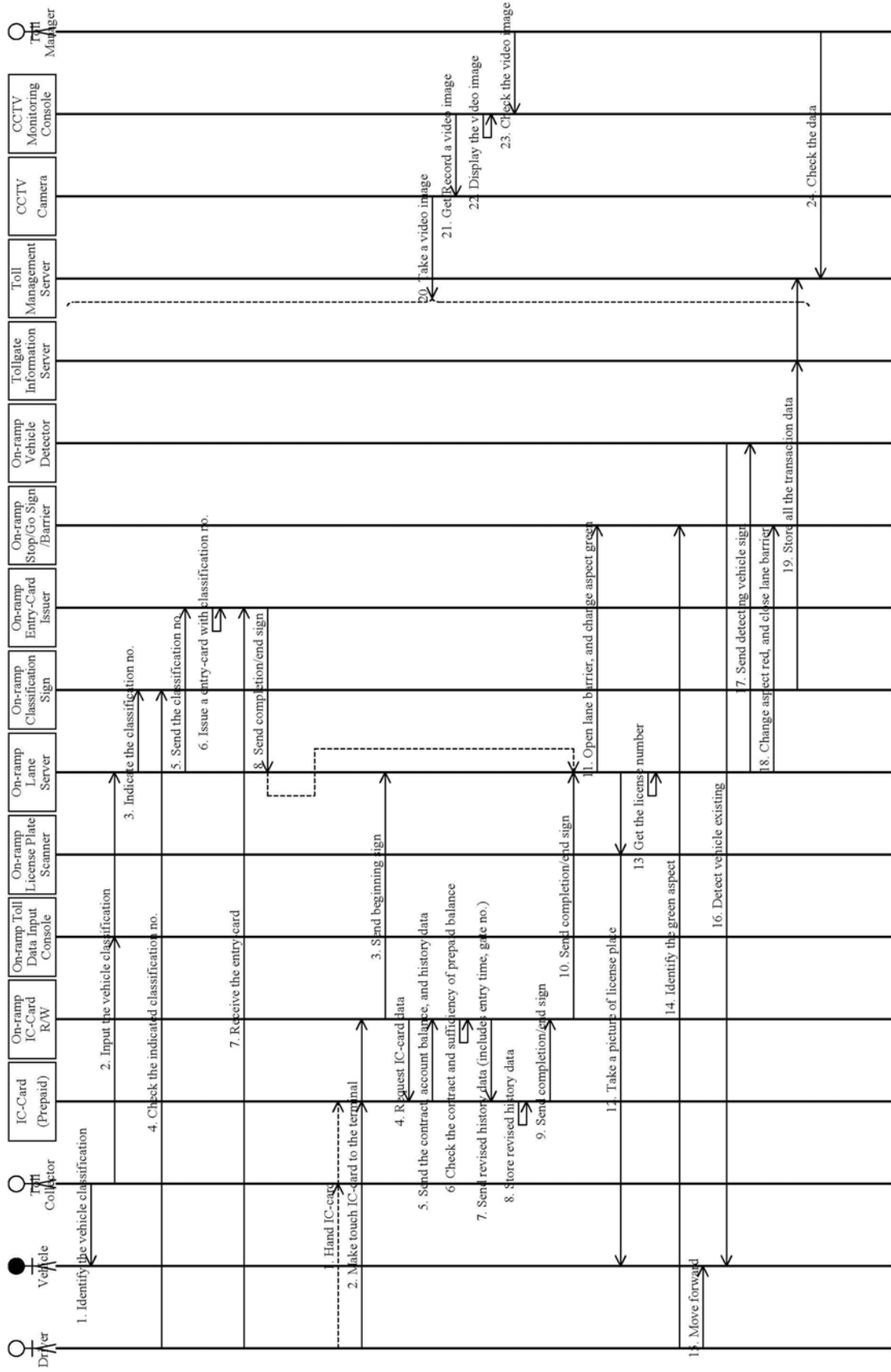


Figure A1.6-(a).MSD Toll Collection by Touch&Go/Manual (2)

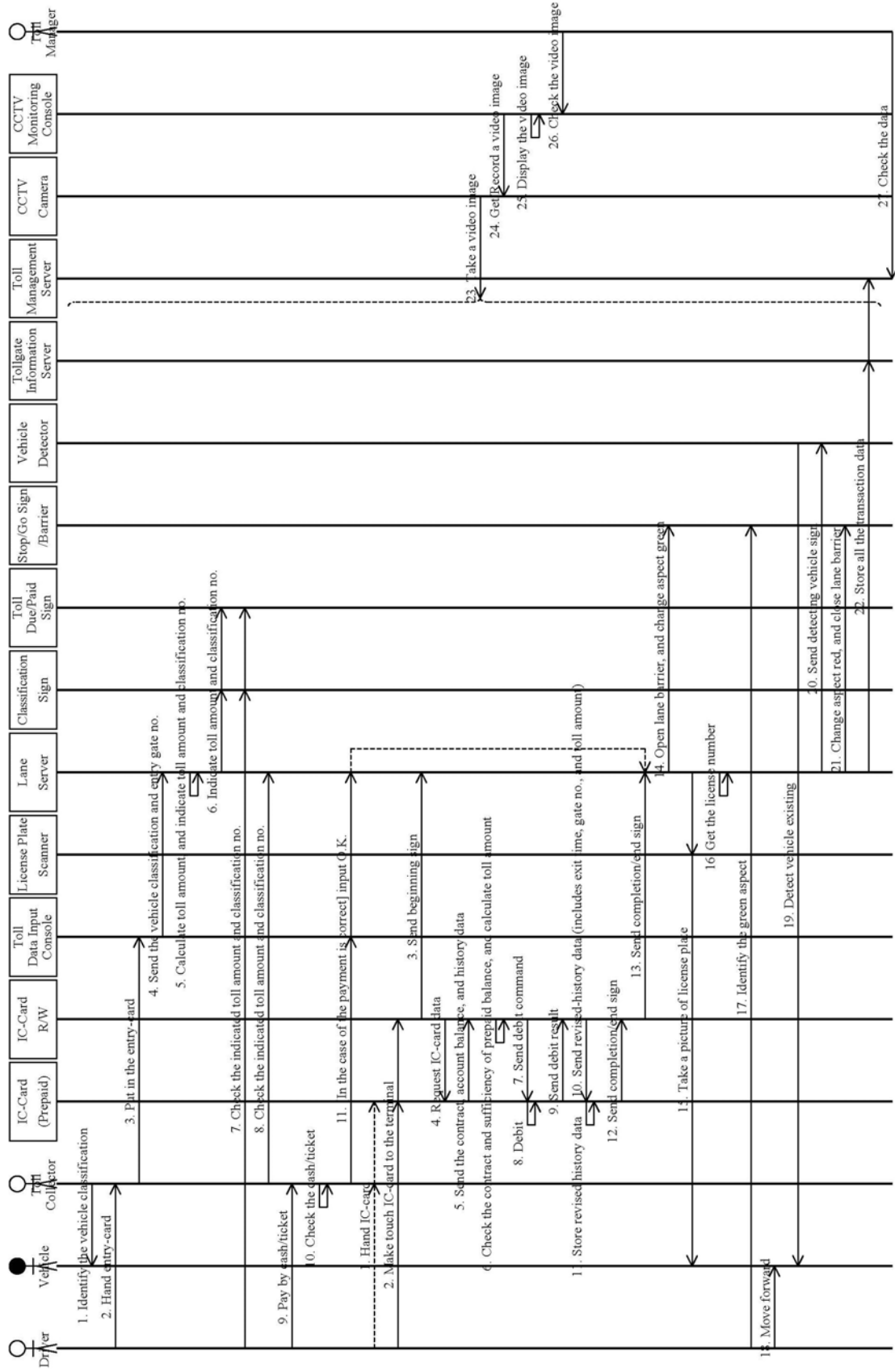


Figure A1.6-(b).MSD Toll Collection by ETC at Toll-island (2-piece-type OBU)

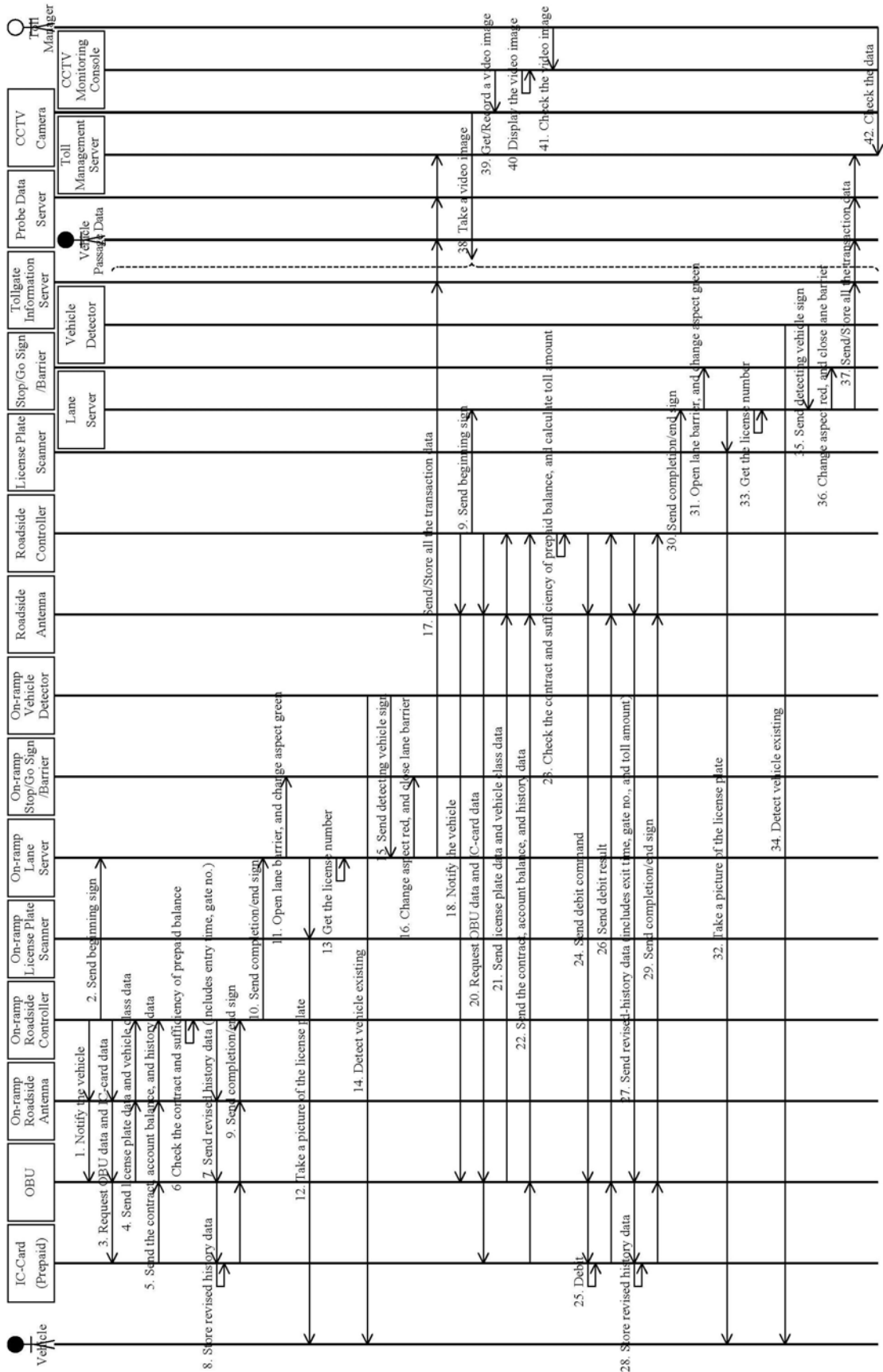


Figure A1.6-(c).MSD Toll Collection by ETC at Toll-island (1-piece-type OBU)

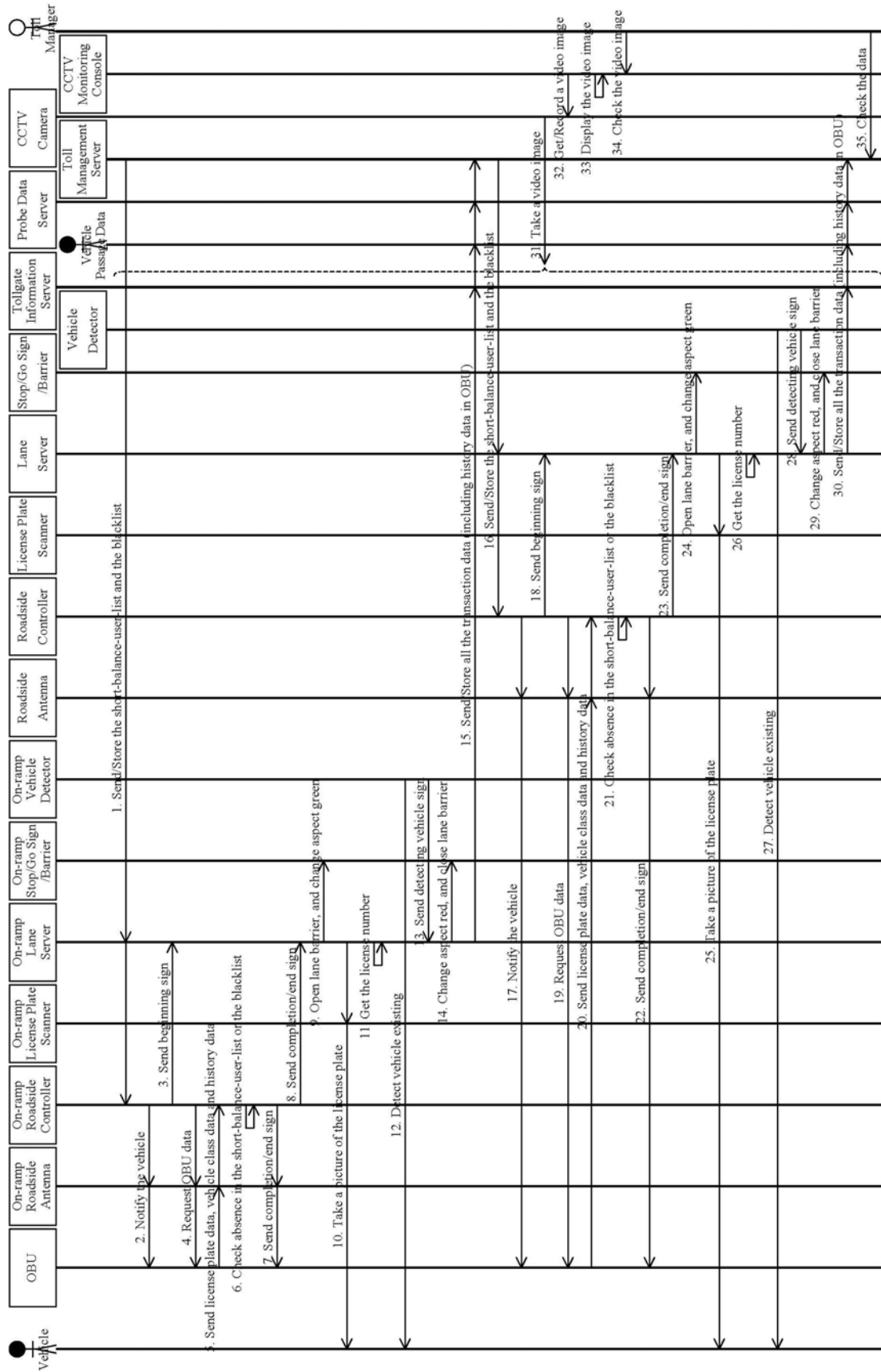
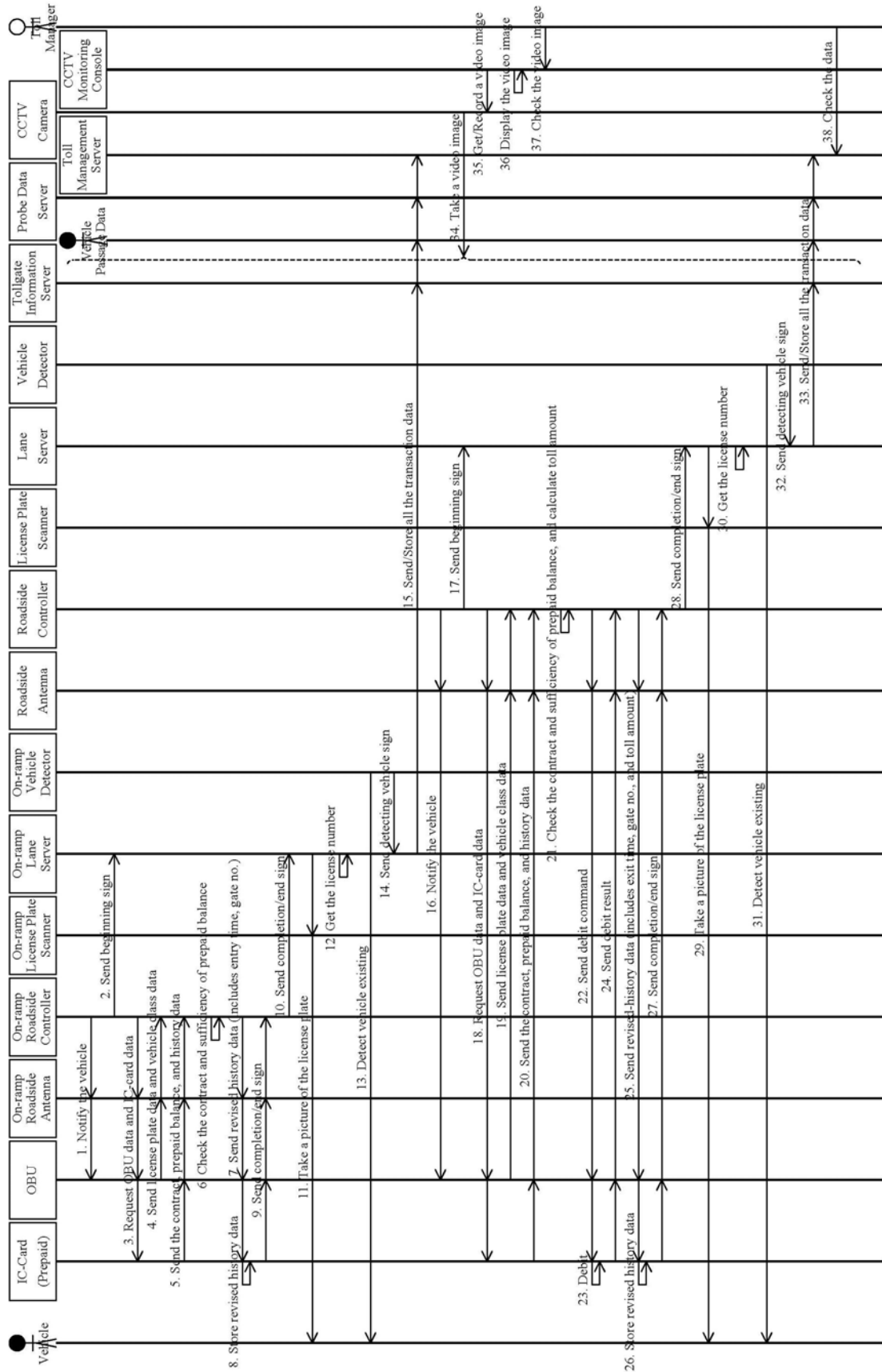


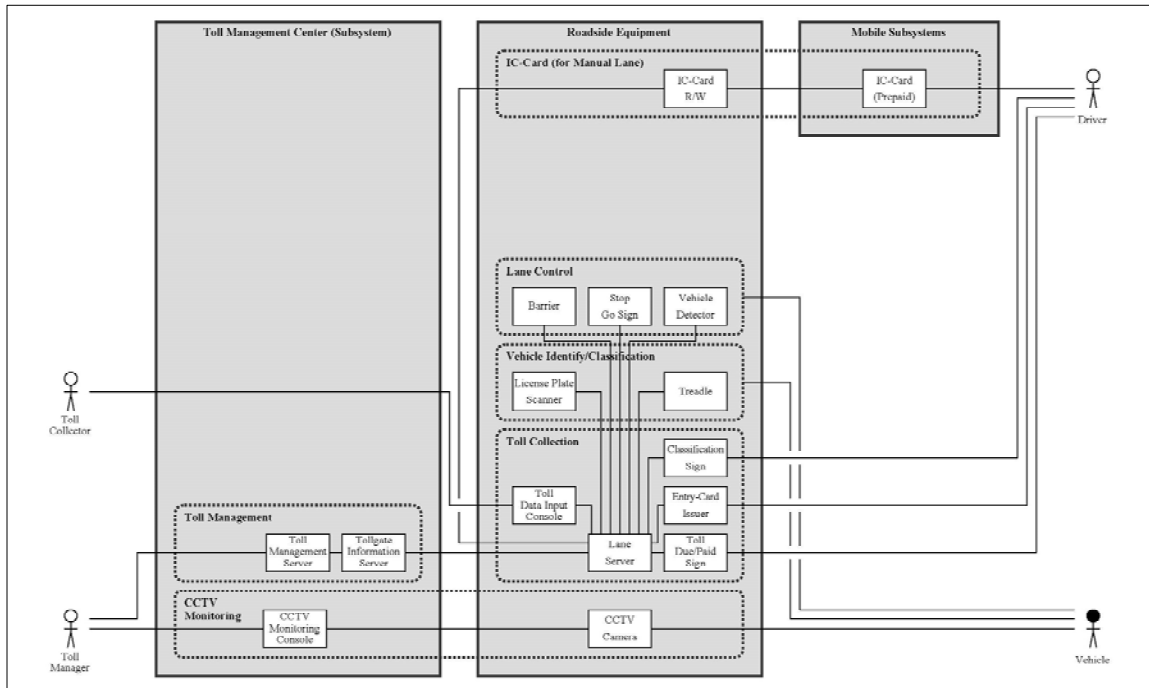
Figure A1.6-(d).MSD Toll Collection by ETC on Free-flow



### 3) Collaboration Diagram with Functions/Installation

The collaboration diagrams (CD) are derived respectively from the message sequence diagrams aforementioned.

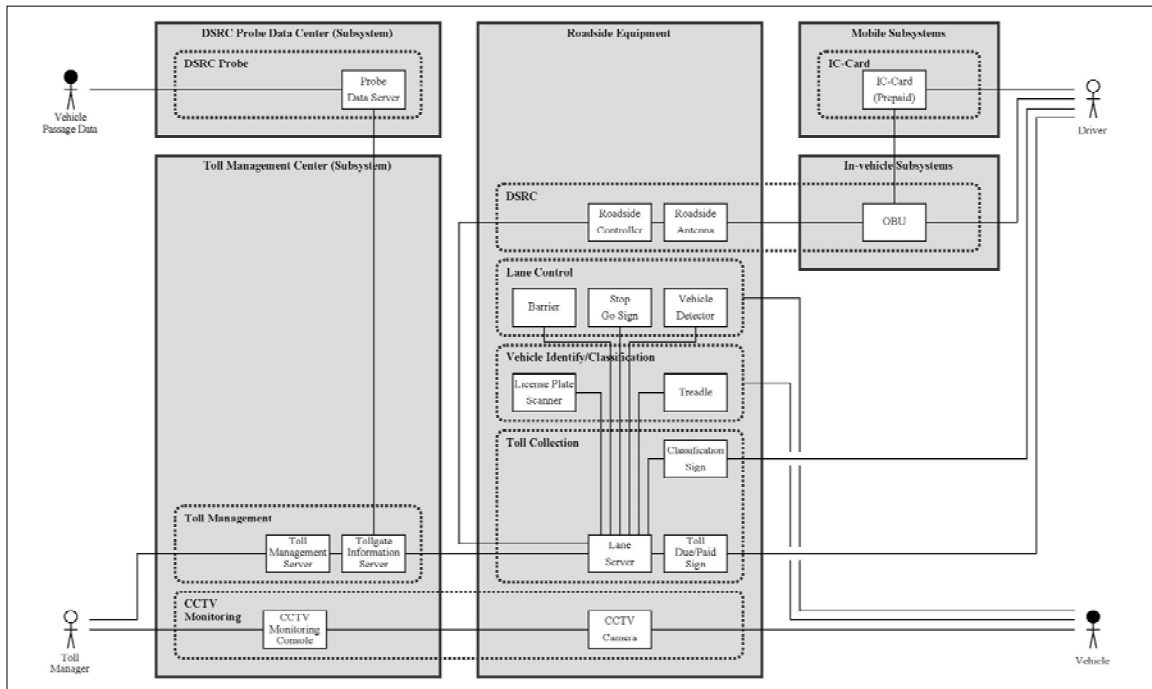
**Figure A1.6-(a).CD Toll Collection by Touch&Go/Manual (Graded as “Useful as a Complement”)**



Functions & Installation: 6-(a) by Touch&Go/Manual		
Function	Equipment	Installation
Toll management	Computer	Toll management center (1st~)
	Computer	Toll management center (1st~)
Toll collection	Console	Roadside (1st~ : every tollgate)
	Computer	Roadside (1st~ : every tollgate)
	Card issuer	Roadside (1st~ : every tollgate)
	Signs	Roadside (1st~ : every tollgate)
Vehicle identify/classification	LP scanner	Roadside (1st~ : every tollgate)
	Treadle	Roadside (1st~ : every tollgate)
IC-card	IC-card	Mobile (1st~)
	Reader/Writer	Roadside (1st~ : every tollgate)
Lane control	Barrier	Roadside (1st~ : every tollgate)
	Stop/Go sign	Roadside (1st~ : every tollgate)
	Detector	Roadside (1st~ : every tollgate)
CCTV monitoring	Console	Toll management center (1st~)
	Camera	Roadside (1st~ : every tollgate)

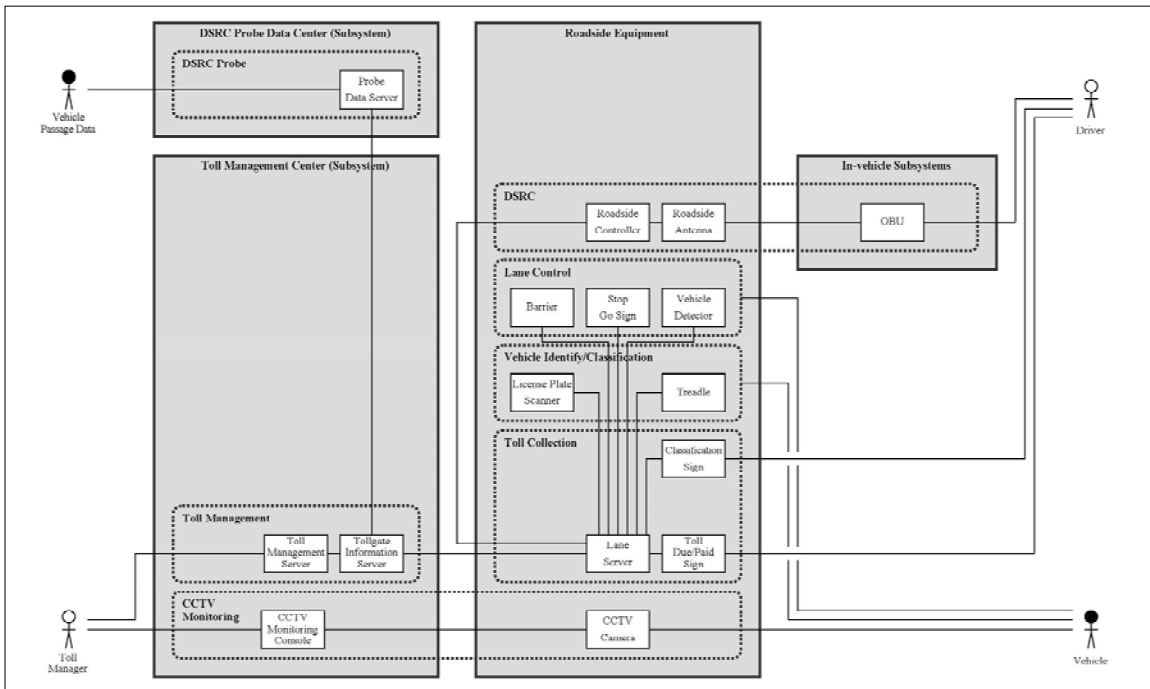


**Figure A1.6-(b).CD Traffic Collection by ETC at Toll Island (2-piece type OBU) (Graded as “Recommended”)**



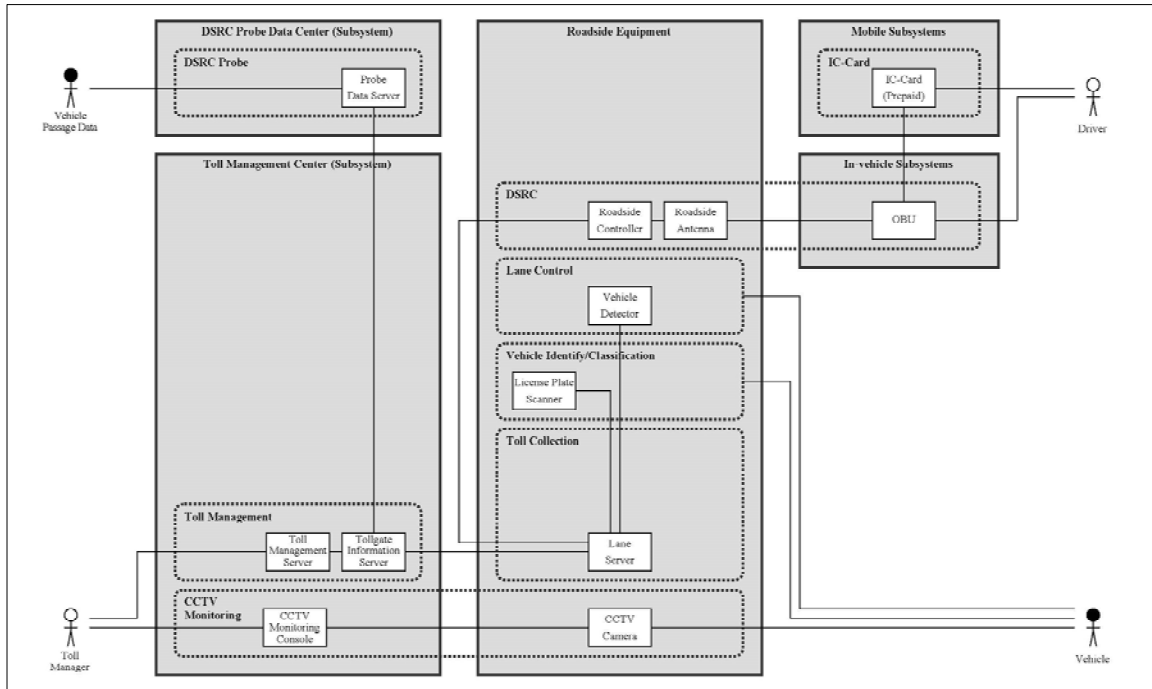
Functions & Installation: 6-(b) by ETC at Toll-island (2-piece Type OBU)			
Function	Equipment	Installation	
Toll management	Computer	Toll management center (1 <sup>st</sup> ~)	
	Computer	Toll management center (1 <sup>st</sup> ~)	
Toll collection	Computer	Roadside (1 <sup>st</sup> ~ : every tollgate)	
	Signs	Roadside (1 <sup>st</sup> ~ : every tollgate)	
Vehicle identify/classification	LP scanner	Roadside (1 <sup>st</sup> ~ : every tollgate)	
	Treadle	Roadside (1 <sup>st</sup> ~ : every tollgate)	
IC-card	IC-card	Mobile (1 <sup>st</sup> ~)	
	DSRC	OBU	In-vehicle (1 <sup>st</sup> ~)
		Antenna	Roadside (1 <sup>st</sup> ~ : every tollgate)
	Computer	Roadside (1 <sup>st</sup> ~ : every tollgate)	
DSRC probe	Computer	DSRC probe data center (2 <sup>nd</sup> ~)	
Lane control	Barrier	Roadside (1 <sup>st</sup> ~ : every tollgate)	
	Stop/Go sign	Roadside (1 <sup>st</sup> ~ : every tollgate)	
	Detector	Roadside (1 <sup>st</sup> ~ : every tollgate)	
CCTV monitoring	Console	Toll management center (1 <sup>st</sup> ~)	
	Camera	Roadside (1 <sup>st</sup> ~ : every tollgate)	

**Figure A1.6-(c).CD Traffic Collection by ETC at Toll Island (1-piece type OBU) (Graded as “Not Suitable”)**



Functions & Installation: 6-(c) by ETC at Toll-island (1-piece Type OBU)		
Function	Equipment	Installation
Toll management	Computer	Toll management center (1 <sup>st</sup> ~)
	Computer	Toll management center (1 <sup>st</sup> ~)
Toll collection	Computer	Roadside (1 <sup>st</sup> ~ : every tollgate)
	Signs	Roadside (1 <sup>st</sup> ~ : every tollgate)
Vehicle identify/classification	LP scanner	Roadside (1 <sup>st</sup> ~ : every tollgate)
	Treadle	Roadside (1 <sup>st</sup> ~ : every tollgate)
DSRC	OBUE	In-vehicle (1 <sup>st</sup> ~)
	Antenna	Roadside (1 <sup>st</sup> ~ : every tollgate)
	Computer	Roadside (1 <sup>st</sup> ~ : every tollgate)
DSRC probe	Computer	DSRC probe data center (2 <sup>nd</sup> ~)
Lane control	Barrier	Roadside (1 <sup>st</sup> ~ : every tollgate)
	Stop/Go sign	Roadside (1 <sup>st</sup> ~ : every tollgate)
	Detector	Roadside (1 <sup>st</sup> ~ : every tollgate)
CCTV monitoring	Console	Toll management center (1 <sup>st</sup> ~)
	Camera	Roadside (1 <sup>st</sup> ~ : every tollgate)

Figure A1.6-(d).CD Traffic Collection by ETC on Free-flow (Graded as “Too Early”)



**Functions & Installation: 6-(d) by ETC on Free-flow**

Function	Equipment	Installation	
Toll management	Computer	Toll management center (1 <sup>st</sup> ~)	
	Computer	Toll management center (1 <sup>st</sup> ~)	
Toll collection	Computer	Roadside (1 <sup>st</sup> ~: every tollgate)	
Vehicle identify/classification	LP scanner	Roadside (1 <sup>st</sup> ~: every tollgate)	
	Treadle	Roadside (1 <sup>st</sup> ~: every tollgate)	
IC-card	IC-card	Mobile (1 <sup>st</sup> ~)	
	DSRC	OBU	In-vehicle (1 <sup>st</sup> ~)
		Antenna	Roadside (1 <sup>st</sup> ~: every tollgate)
	Computer	Roadside (1 <sup>st</sup> ~: every tollgate)	
DSRC probe	Computer	DSRC probe data center (2 <sup>nd</sup> ~)	
Lane control	Detector	Roadside (1 <sup>st</sup> ~: every tollgate)	
CCTV monitoring	Console	Toll management center (1 <sup>st</sup> ~)	
	Camera	Roadside (1 <sup>st</sup> : every tollgate)	

## A1.7 Overloading Regulation

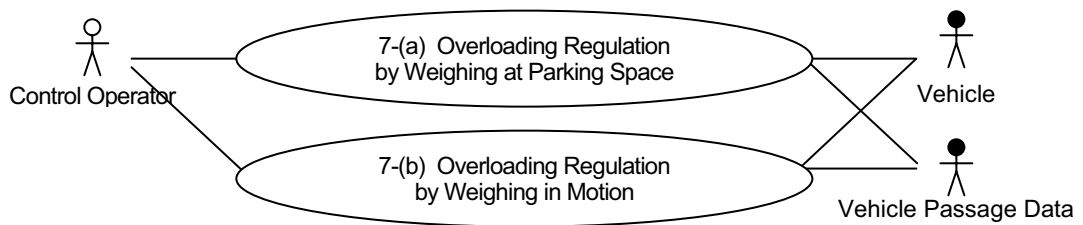
### 1) Service Requirements and Use Cases

#### (1) 1st Stage

- (i) Weighing heavy trucks with/without stopping them,
- (ii) Identification of illegally loading (including/excluding the vehicle weight according to the standardization),
- (iii) Assist the regulation of illegally loading (according to the standardized procedure of the standalone method to weigh/reject the overloaded trucks at roadside, or of the online method to store overloading records in the negative database for the penalty later on).

The following two alternative use cases are to be considered in the discussion.

**Figure A1.7.1 Use Case Diagram of Overloading Regulation**



Source: VITRANSS 2 Study Team

### 2) Message Sequence Diagram

The message sequence diagram (MSD) of the use cases above are shown in the following pages.

Figure A1.7-(a).MSD Overloading Regulation by Weighing at Parking Space

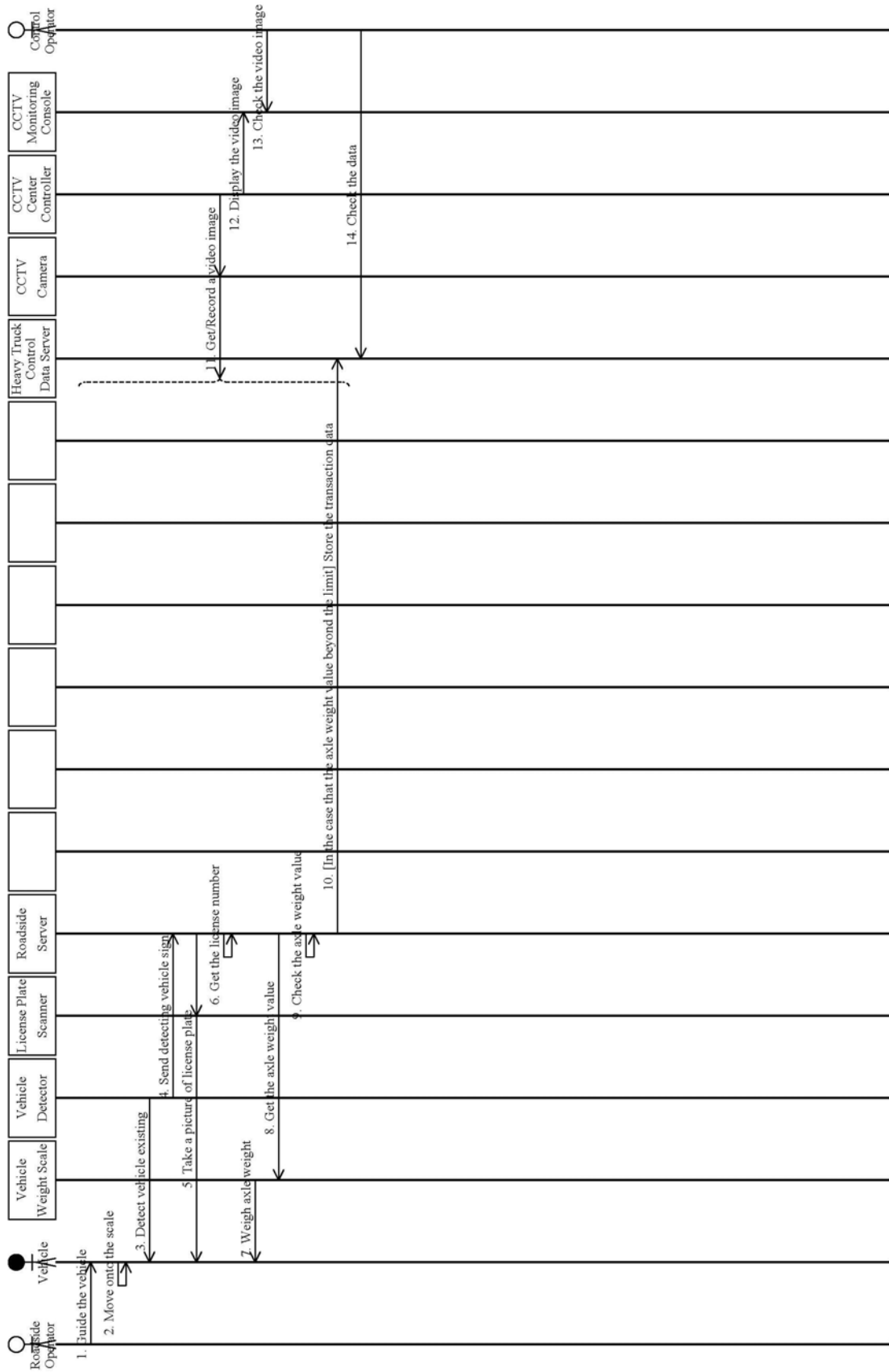
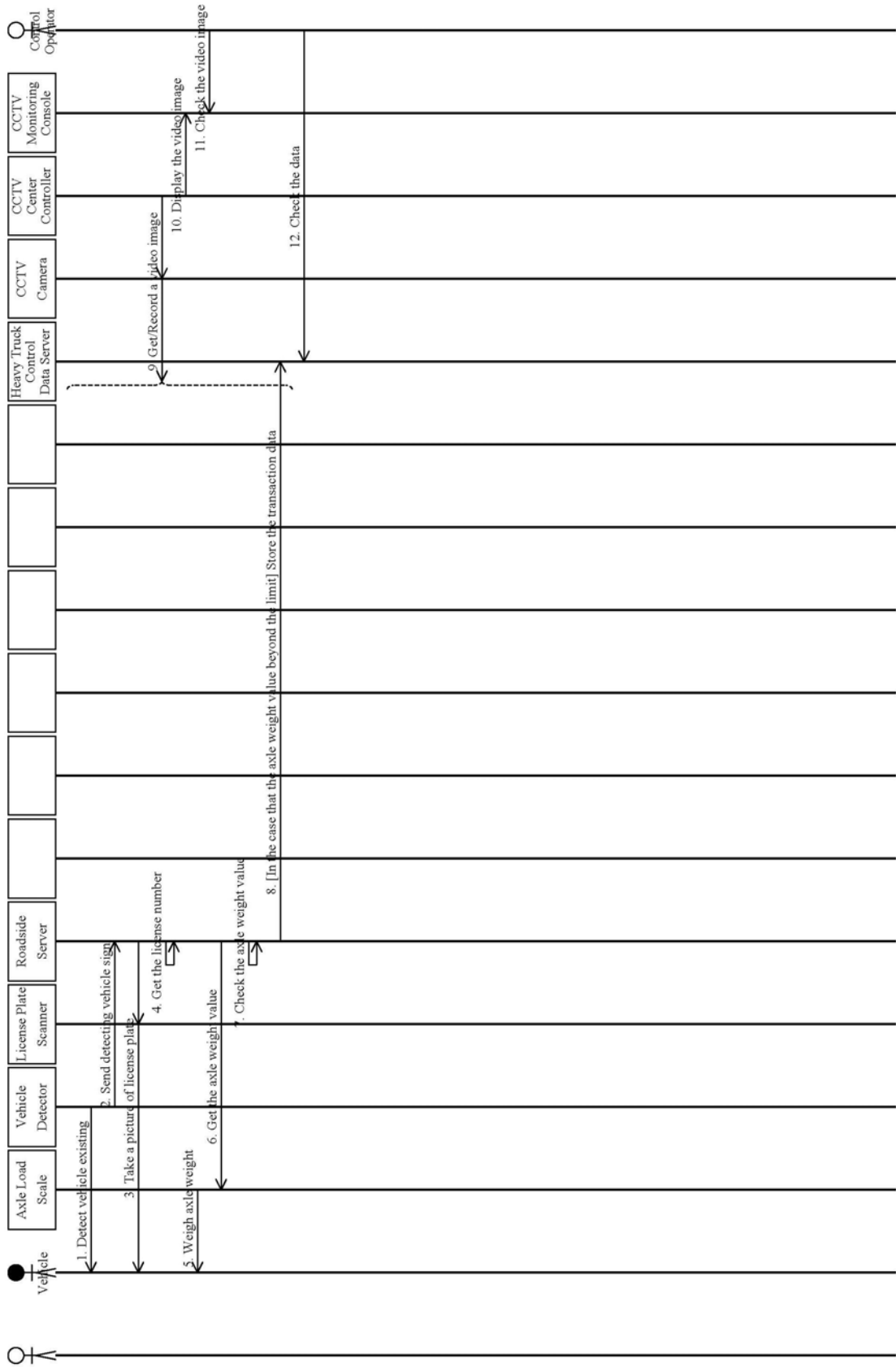


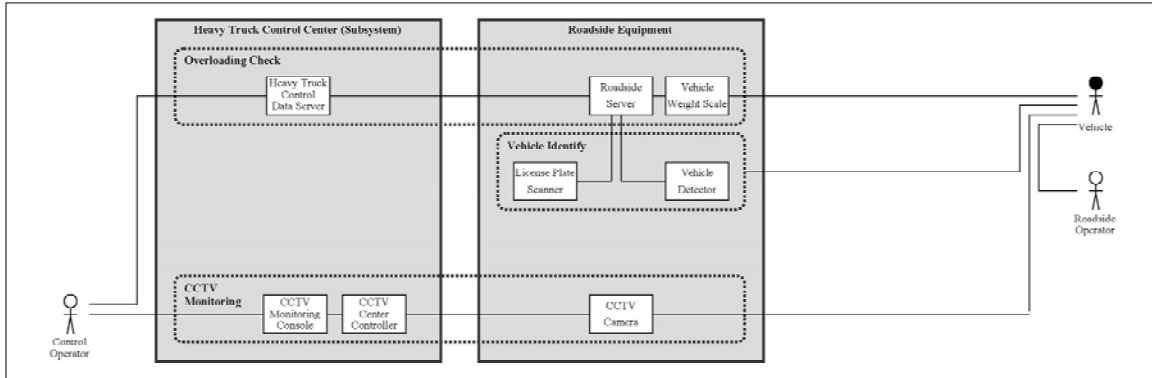
Figure A1.7-(b).MSD Overloading Regulation by Weighing in Motion



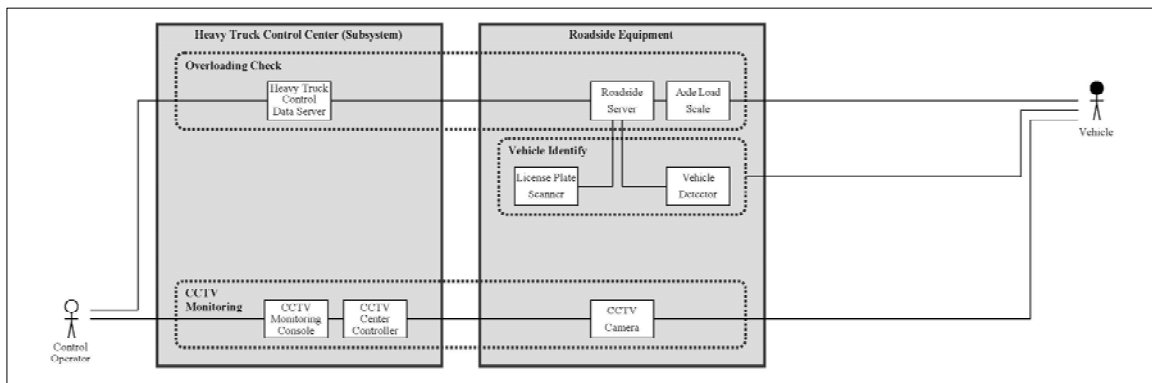
### 3) Collaboration Diagram with Functions/Installation

The collaboration diagrams (CD) are derived respectively from the message sequence diagrams aforementioned.

**Figure A1.7-(a).CD Overloading Regulation by Weighing at Parking Space (Graded as “Not Suitable”)**



**Figure A1.7-(b).CD Overloading Regulation by Weighing in Motion (Graded as “Recommended”)**



Functions & Installation: 7-(b) by Weighing in Motion		
Function	Equipment	Installation
Overloading Check	Computer	Heavy truck control center (1 <sup>st</sup> ~)
	Computer	Roadside (1 <sup>st</sup> ~ : every tollgate)
	Axle scale	Roadside (1 <sup>st</sup> ~ : every tollgate)
Vehicle Identify	LP scanner	Roadside (1 <sup>st</sup> ~ : every tollgate)
	Detector	Roadside (1 <sup>st</sup> ~ : every tollgate)
CCTV	Console	Heavy truck control center (1 <sup>st</sup> ~)
	Computer	Heavy truck control center (1 <sup>st</sup> ~)
	Camera	Roadside (1 <sup>st</sup> ~ : every tollgate)