Technical Regulation of Bus Information Exchanges(C2C)

MLTM
Ministry of Land,
Transport and Maritime Affairs

⟨ Contents ⟩

1. OBJECTIVE

o This regulation is designed to obtain an efficient system architecture and operation associated with public transport, in particular bus system, a fast and accurate data collection and information interchange, and an interactive system related to information interchange between centers.

2. SCOPE

o This technical regulation is primarily applied to "public system", which is designed and operated by local government, public organization or public institution or a system associated with the public system.

o This technical regulation is fundamentally designed for "bus" running multiple bus stops, except for express bus.

3. BUS INFORMATION TYPE

o Bus information classifies into two types: **bus management information** for managing and operating bus systems and **bus guidance information** for providing bus information to users.

o **Bus management information** includes bus location information, bus route schedule plan and bus operation, schedule management, and incident situation in order for safety of users and management of bus operation.

o **Bus guidance information** consists of bus location information, expected bus arrivals, and bus schedules in order to provide the opportunity of bus choice and the convenience of boarding/un-boarding bus to users.

4. INFORMATION INTEGRATION

○ Regardless of data collection methods and related agencies, and the existence of bus information integration, bus information should follow the scheme below for the purpose of interoperation.
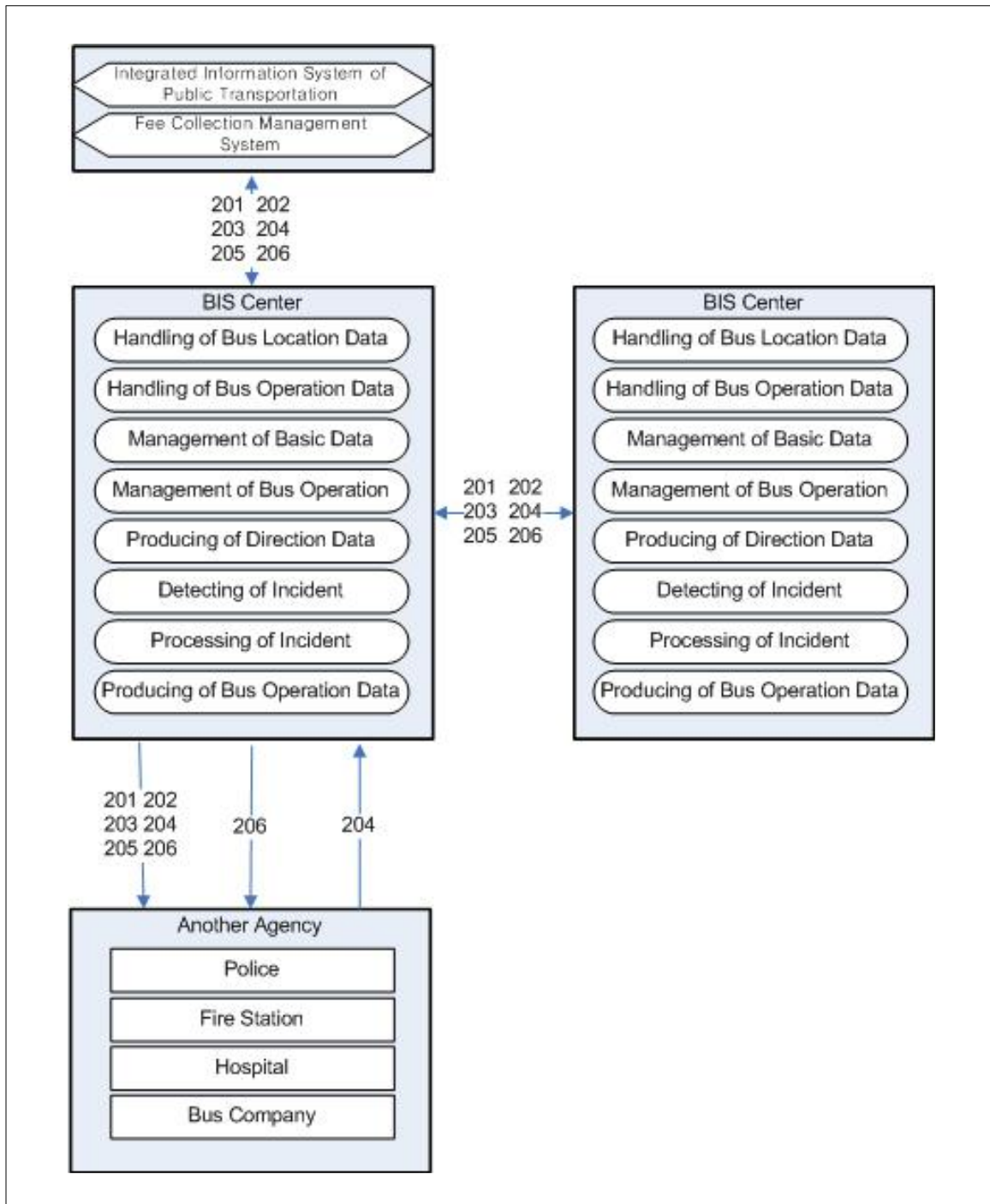
○ An agency in charge of collecting and handling bus management information has to provide highly reliable information.

○ An agency in charge of collecting/handling/providing bus guidance information must provide highly reliable information.

○ If bus information is collected/handled/provided by multi-agency, not single agency, an agency in charge of each task associated with bus information has a responsibility to provide reliable information. If information integration is required, an agency providing information has a responsibility to achieve highly reliable information.

5. CLASSIFICATION AND INPUT CRITERIA OF BUS INFORMATION

○ Bus information can be classified into information interchange cycle and interface. The detailed information classification by information ID and its descriptions is shown in Table 1.

<Table 1> Specific information classification

ID	Name	Contents	Cycle	Interface
201	Bus Location Information	Vehicle ID, Route ID, BIT ID of last Bus, Message generation time of event information, Node ID of collected event information, Time of node in & out, travel-time in node, Polling information(GPS data), Collecting time of GPS data, Collecting cycle of GPS data	Real-Time	Center to Center
202	Estimated time Information of BUS Arrival	BIT ID, Route ID, Vehicle ID, Estimated time of bus	Real-Time	Center to Center
203	Bus Schedule Planning Information	Route information, Added route information, Route guide information, Frequency of bus, Update time and contents	When changed	Center to Center

ID	Name	Contents	Cycle	Interface
204	Directions Information of Bus Running	Vehicle ID, Next bus stop(BIT) ID, Direction of bus headway, Directions of bus running	When needed[※]	Center to Center
205	Bus operation Information	Vehicle ID, Node ID of collected event information, Polling information(GPS data), Type of Irregular bus operations, Route ID and the number of not running bus without notice	When needed[※]	Center to Center
206	Bus Incident Information	Vehicle ID, Route ID, Node ID of collected event information, Polling information(GPS data), Location of occurred Incident, Time of occurred incident, Type of occurred incident	When occurred	Center to Center

○ In order to guarantee the compatibility of bus information exchange, vehicle identification(ID), BIT ID, and route ID and bus route schedule has to be designed/planned based on the manual, "Fundamental information construction and management strategies of bus information systems" provided by the Ministry of Land. Transport and Maritime Affairs (MLTM). If a management system is constructed and operated based on the manual, fundamental information from the management system is mainly used without exchanging "203. route schedule information" between centers.

※ "204. bus schedule planning information" and "205. bus operation information" are applied when data collector and service provider are different. When needed, it has to be operated by technical regulation.

5.1. Bus Location Information

○ Type and detailed content of bus location information that is crucial for bus management information and bus guidance information are presented in table below. In addition, the table also describes the input criteria for bus location information.

Information Name	Bus Location Information
Name in ITS Architecture	Bus Location Information
Contents	Vehicle ID, Route ID, BIT ID of last Bus, Message generation time of event information, Node ID of collected event information, Time of node in & out, travel-time in node, Polling information(GPS data), Collecting time of GPS data, Collecting cycle of GPS data
Description	If bus location information is collected from the outside of management area, for the purpose of data handing and service, bus location information has to be provided to the other centers with the following manner.

```
BusLocationInfo ::= SEQUENCE
{
   tsfc-PTVehicleIDNumber            UTF8String      (SIZE(1..255)),
   busLocationInfoType               CHOICE
   {
      busLocationEvent               BusLocationEvent,
      busLocationPolling             BusLocationPolling
   },
   tpif-SubRouteIdentityNumber       UTF8String      (SIZE(1..255)),
   tsfc-LastPTVehicle                BOOLEAN                     OPTIONAL,
   tpif-LastPTVehicleBITIdentifyNumber   UTF8String  (SIZE(1..40)) OPTIONAL
}
BusLocationEvent ::= SEQUENCE
{
      tsmg-MessageGenerationTime     GeneralizedTime,
      tsvh-NodeZoneIDNumber          UTF8String      (SIZE(1..40)),
      tsvh-NodeZoneEntryTime         GeneralizedTime              OPTIONAL,
      tsvh-NodeZoneExitTime          GeneralizedTime              OPTIONAL,
      tsvh-NodeZoneTripTime          INTEGER         (0..1200)    OPTIONAL
}
BusLocationPolling ::= SEQUENCE
{
      tsfc-PTVehicleCoordinate       NMEACoord※                   OPTIONAL,
      tsfc-PTVehicleCollectedTime    GeneralizedTime              OPTIONAL,
      tsfc-PTVehicleCollectedCycleTime  INTEGER      (0..3600)    OPTIONAL
}
```

※ When GPS coordinates are used for bus location information between centers, the GPS coordinate is defined by the values of "NMEACoord"

```
NMEACoord ::= SEQUENCE {
      latitude            SEQUENCE {
                integerValue         INTEGER,
                fractionValue        INTEGER,
                fracSize             INTEGER(0..10),
                compass              ENUMERATED { north, south }
      },
      longitude           SEQUENCE {
                integerValue         INTEGER,
                fractionValue        INTEGER,
                fracSize             INTEGER(0..10),
                compass              ENUMERATED { east, west }
      },
      optData                        OCTET STRING         OPTIONAL
}
```

5.2. Estimated Time Information of Bus Arrival

○ Type and detailed contents of expected bus arrival information for the convenience of bus users are described in table below. Furthermore, the table consists of the input criteria for estimated time information of bus arrival.

Information Name	Estimated Time Information of Bus Arrival
Name in ITS Architecture	Estimated Time Information of Bus Arrival
Contents	BIT ID, Route ID, Vehicle ID, Estimated time of bus
Description	Directly provided to BIT equipment, on-board equipment, and personal equipment. Provide information in conjunction with area-wide center or adjacent center or provide refined information considering incident data

```
ArrivalPredictionTimeInfo ::= SEQUENCE
{
    tsmg-MessageGenerationTime        GeneralizedTime,
    tpif-BITIdentifyNumber            UTF8String      (SIZE(1..40)),
    tpif-SubRouteIdentityNumber       UTF8String      (SIZE(1..255)),
    tsfc-PTVehicleIDNumber            UTF8String      (SIZE(1..255)),
    tpif-AccesspointArrivalTime       INTEGER         (0..72000),
    tpif-LastBITIdentifyNumber        UTF8String      (SIZE(1..255))   OPTIONAL,
    tsvh-LastBITZoneEntryTime         GeneralizedTime                  OPTIONAL,
    tsvh-LastBITZoneExitTime          GeneralizedTime                  OPTIONAL,
    tsvh-LastBITZoneTripTime          INTEGER         (0..1200)        OPTIONAL,
    tsvh-RollingAverageSpeedRate      INTEGER         (0..300)         OPTIONAL,
    tsfc-LastPTVehicle                BOOLEAN                          OPTIONAL
}
```

5.3. Bus Schedule Planning Information

○ Type and specific descriptions of bus schedule planning information (i.e., bus operation schedule and changes in bus schedule) for the convenience of bus users are summarized in table below.

Information Name	Bus Schedule Planning Information
Name in ITS Architecture	Bus Schedule Planning Information
Contents	Route information, Added route information, Route guide information, Frequency of bus, Update time and contents
Description	When bus schedule planning needs to be adjusted, input the same information one time earlier, then utilize bus directions, and collaboration between centers or use trip scheduling of users

```
RouteSchedulePlanning ::= SEQUENCE
{
      tsmg-MessageGenerationTime            GeneralizedTime,
      tpif-SubRouteIdentityNumber           UTF8String      (SIZE(1..255)),
      tpif-SubRouteNameText                 UTF8String      (SIZE(1..255))     OPTIONAL,
      tpif-RouteGuide                       SEQUENCE OF  RouteGuide,
      tpif-BeginBITIdentifyNumber           UTF8String      (SIZE(1..40))      OPTIONAL,
      tpif-EndBITIdentifyNumber             UTF8String      (SIZE(1..40))      OPTIONAL,
      scrn-TimeBeginTime                    GeneralizedTime                    OPTIONAL,
      scrn-TimeEndTime                      GeneralizedTime                    OPTIONAL,
      tpif-PicktimeHeadwayTime              INTEGER         (0..86400)         OPTIONAL,
      tpif-NonPicktimeHeadwayTime           INTEGER         (0..86400)         OPTIONAL,
      tsvh-PTVehicleFrequencyQuantity       INTEGER         (0..1440)          OPTIONAL,
      tpif-RouteSchedulePlanningUpdatedTime        GeneralizedTime OPTIONAL,
      tpif-RouteSchedulePlanningUpdatedContents    UTF8String      (SIZE(1..255))
OPTIONAL
}
RouteGuide ::=                        UTF8String
```

5.4. Directions Information of Bus Running

ㅇ Type and specific descriptions of bus service directions information mitigating inconvenience of bus user when current bus schedule cannot follow the plan are summarized in table below.

Information Name	Directions Information of Bus Running
Name in ITS Architecture	Rearrangements Information of Bus Running
Contents	Vehicle ID, Next bus stop(BIT) ID, Direction of bus headway, Directions of bus running
Description	Corresponding to incident information or bus schedule planning information, bus service directions information should be adjusted.

```
OperationPlanning ::= SEQUENCE
{
    tsmg-MessageGenerationTime        GeneralizedTime,
    tsfc-PTVehicleIDNumber            UTF8String     (SIZE(1..255)),
    tpif-NextBITIdentifyNumber        UTF8String     (SIZE(1..40)),
    tpif-HeadwayTimeOffsetQuantity    INTEGER        (-600..600),
    scrn-ServiceDirectionCode         BIT STRING
    {
        break             (0),
        commit-PTVehicle  (1),
        stand-by          (2)
    }OPTIONAL
}
```

5.5. Bus Operation Information

○ Types and detailed descriptions of bus operation information in order for reliable service plan of bus operation or for the safety of bus driver and bus users at bus stops are presented in table below.

Information Name	Bus Operation Information
Name in ITS Architecture	State of Bus Operation Information
Contents	Vehicle ID, Node ID of collected event information, Polling information(GPS data), Type of Irregular bus operations, Route ID and the number of not running bus without notice
Description	For the enhancement of public transit service and safety based on bus operation plan

```
BusOperationConditions ::= SEQUENCE
 {
    tsmg-MessageGenerationTime              GeneralizedTime,
    tsfc-PTVehicleIDNumber            UTF8String (SIZE(1..255)),
    tsvh-NodeZoneIDNumber             UTF8String (SIZE(1..40)) OPTIONAL,
    tsfc-PTVehicleCoordinate          NMEACoord      OPTIONAL,
    scrn-VehicleIrregularConditionCode    BIT STRING
    {        non-stop                 (0),
             start-doors-open         (1),
             stop-irregular-position  (2),
             speed-violation          (3),
             route-deviation          (4),
             subroute-change          (5),
             arbitrary-parking        (6),
             suspended-operation      (7)
    }OPTIONAL,
    scrn-MissingRouteIDNumber         UTF8String (SIZE(1..255)) OPTIONAL,
    scrn-MissingCountQuantity         INTEGER         (1..100) OPTIONAL,
    tpif-SubRouteIdentityNumber       UTF8String (SIZE(1..255)) OPTIONAL,
    tpif-SubRouteNameText             UTF8String (SIZE(1..255)) OPTIONAL

 }
```

5.6. Bus Incident Information

○ Incident is sometimes occurred during bus service based on operation plan. Type and detailed descriptions including input criteria of bus incident information are described in table below.

Information Name	Bus Incident Information
Name in ITS Architecture	Complementary Information of Incident Situation
Contents	Vehicle ID, Route ID, Node ID of collected event information, Polling information(GPS data), Location of occurred Incident, Time of occurred incident, Type of occurred incident
Description	Incident information occurred by operated public transit

```
CurrentIncidentsStatus ::= SEQUENCE
{
    tsmg-MessageGenerationTime          GeneralizedTime,
    tsfc-PTVehicleIDNumber              UTF8String      (SIZE(1..255))      OPTIONAL,
    tpif-SubRouteIdentityNumber         UTF8String      (SIZE(1..255))      OPTIONAL,
    tsvh-NodeZoneIDNumber               UTF8String      (SIZE(1..40))       OPTIONAL,

    tsfc-PTVehicleCoordinate            NMEACoord                           OPTIONAL,

    evnt-LocationRoadwayNameText        UTF8String      (SIZE(1..64))       OPTIONAL,
    evnt-LocationCrossStreetBeginText   UTF8String      (SIZE(1..64))       OPTIONAL,
    tfmg-IncidentLocationText           UTF8String      (SIZE(1..255))      OPTIONAL,
    tfmg-IncidentGeneratedTime          GeneralizedTime,
    tsin-IncidentDescriptionLongText    UTF8String      (SIZE(1..255))      OPTIONAL,
    tfmg-IncidentType                   BIT STRING
    {
        ptvehicleBreakDown          (0),
        ptvehicleAccident           (1),
        emergencySituation          (2),
        incidentInPtvehicle         (3),
        passingControl              (4),
        notPermitOperation          (5)     }OPTIONAL,
    tsin-IncidentTypeOtherText          UTF8String      (SIZE(1..255))      OPTIONAL,
    tsin-IncidentLevelCode              ENUMERATED
    {
        incidentDetected            (0),
        confirmedAndResponding      (1),
        clearedAndRecovering        (2),
        overAndDone                 (3)     }OPTIONAL,
    tsin-IncidentLevelOtherText         UTF8String      (SIZE(1..255))      OPTIONAL
}
```

6 COMMUNICATION PROTOCOL FOR DATA EXCHANGE

o Sending/receiving protocol for traffic information or information between bus and center is defined below.

6.1. Data Exchange
□ **Communication method**

o TCP/IP is applied for C2C communication.

□ **Data exchange procedure**

o Use communication procedure between client and server defined by national standard (KS X ISO 14827-2) for traffic information exchange

□ **Data packet structure**

o Use Datex data packet structure (A, B) defined by ASN.1 of national standard (KS X ISO 14827-2) for traffic information exchange.

6.2. Identification (ID) for exchanging public transit information
□ **ID assignment for public transit facility and its location**

o ID assignment and management necessary for public transit information exchange (i.e., Vehicle ID, BIT ID, Route ID, Node ID, etc) follow the methods provided by the Ministry of Land. Transport and Maritime Affairs (MLTM).

- Fundamental information construction and management strategies of bus information systems.

- Criteria for setting standard nodes and links of intelligent

transportation systems (ITS)

- Management strategies for standard nodes and links of ITS

6.3. Message Encoding Rule for telecommunication

□ Transfer Syntax for sending/receiving ASN.1 message types

o TLV Encoding method defined by an International standard, CCITT X.690, ISO 8825, as a basic encoding rule.

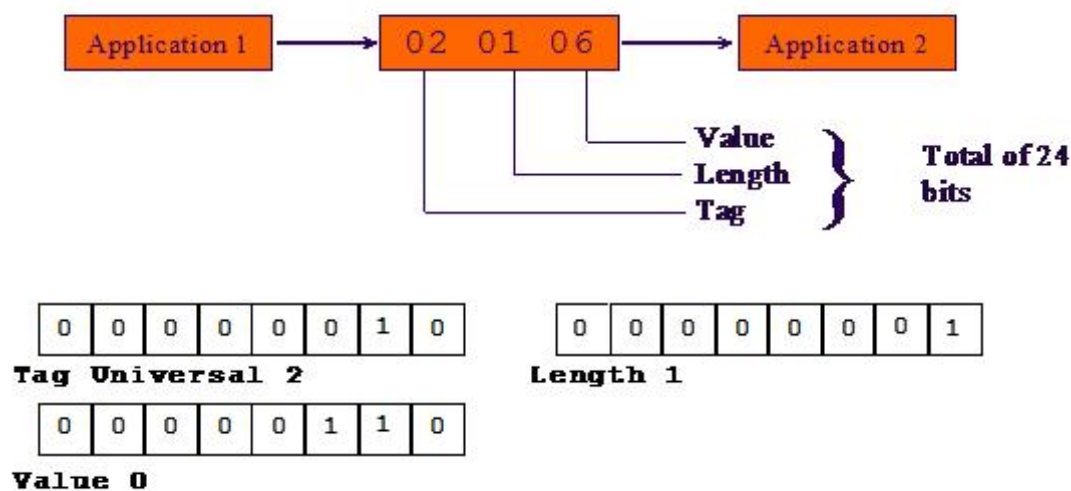| Type Field	Length Field	Value Field

- Type Field: Identifier of encoding structure

- Length Field : determine a number of Octet included in Value Field

- Value Field : 0 or more contents of Octet

□ Application example of TLV Encoding

o TLV encoding method for single data type

o TLV Encoding method for multiple data type (Sequence, SET,

Choice, etc)

```
Message ::= SEQUENCE {
    version         INTEGER         (0.. 20),
    community       OCTET STRING
}
```

Sample Message ::= { 0, 'EB069937'h }

0	0	1	1	0	0	0	0

Tag universal 16

0	0	0	0	1	0	0	1

Length 9

0	0	0	0	0	0	1	0

Value (1 of 9) integer

0	0	0	0	0	0	0	1

Value (2 of 9) integer

0	0	0	0	0	0	0	0

Value (3 of 9) integer

0	0	0	0	0	1	0	0

Value (4 of 9) OCTET STRING

0	0	0	0	0	1	0	0

Value (5 of 9) OCTET STRING

1	1	1	0	1	0	1	1

Value (6 of 9) OCTET STRING

0	0	0	0	0	1	1	0

Value (7 of 9) OCTET STRING

1	0	0	1	1	0	0	1

Value (8 of 9) OCTET STRING

0	0	1	1	0	1	1	1

Value (9 of 9) OCTET STRING