TECHNICAL REPORT

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Intelligent transport systems — Interactive centrally determined route guidance (CDRG) — Air interface message set, contents and format

Systèmes intelligents de transport — Guidage routier déterminé centralement interactif (CDRG) — Jeu de message d'interface d'air, contenu et format

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Foreword

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The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

In exceptional circumstances, when a technical committee has collected data of a different kind from that which is normally published as an International Standard ("state of the art", for example), it may decide by a simple majority vote of its participating members to publish a Technical Report. A Technical Report is entirely informative in nature and does not have to be reviewed until the data it provides are considered to be no longer valid or useful.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO/TR 17384 was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

Introduction

The interactive CDRG system provides a driver with a recommended route to his or her destination. The recommended route is sent as a route object that is utilized to display the route on the navigation map or to produce driving direction instructions. This recommended practice, however, only describes the transferring information, such as route object, that is required for CDRG. How the transferred information is used onboard is left to the in-vehicle unit designer. Because, in some countries, interactive CDRG systems are being developed and implemented using beacon or cellular phone technologies, we recognize the necessity for standardizing message sets for interactive CDRG. By the standardized interactive CDRG message set, drivers will be able to receive CDRG service on the same in-vehicle unit regardless of which CDRG service area the in-vehicle unit has entered.

To help understand the functional and technical aspect of the interactive CDRG, implementation experiments of such a system are explained in Annex A.

Intelligent transport systems — Interactive centrally determined route guidance (CDRG) — Air interface message set, contents and format

1 Scope

This Technical Report describes the message contents and format of the air interface between the infrastructure and the in-vehicle unit in the Interactive CDRG system. The scope of standardization work will be the message set requirements for the air interface.

a) The air interface message set for route guidance information in the interactive CDRG system in this Technical Report is applicable to both vehicles equipped with an onboard map database and those which are not equipped (i.e. those equipped with simplified graphic output and/or text message display functions).

b) This Technical Report covers media independent systems. In this Technical Report, messages required for both cellular phone-based CDRG and beacon-based CDRG have been taken into account.

c) The size of each message is defined by considering the “In-vehicle Navigation Systems Communication Device Message Set Requirements”.

d) When applying this Technical Report, which is recommended practice to the implementation of any CDRG system, any values less than the defined field size values are allowed, as great importance is attached to the communication efficiency, and the order of description of messages proposed in the message set of this Technical Report might not necessarily be observed.

2 Abbreviations

CDRG	Centrally Determined Route Guidance
LDRG	Locally Determined Route Guidance
SRG	Static Route Guidance
MDRG	Multi-mode Determined Route Guidance
OD	Origin-Destination

3 Definitions of special terminology

Table 1 lists definitions of special terminology.

Table 1 — Special terminology

Term	Definition/explanation
Connecting network information	By indicating how the links and major roads ahead of the vehicle's present position are configured, connecting network information realizes Interactive CDRG even for vehicles not equipped with onboard map databases.
Downlink	The downlink refers to that portion of a communications link used for the transmission of information from the infrastructure to each in-vehicle unit.
Infrastructure	The infrastructure handles communications with each vehicle. Installed alongside the road, the infrastructure collects data from each vehicle, provides data to the vehicle and performs any related information processing.
Interactive two-way communication	Following the reception of destination and related information from the in-vehicle unit, the infrastructure provides the in-vehicle unit with information that defines the recommended route, describes route conditions, and provides an estimated travel time to the destination.
LDRG	Under LDRG, the vehicle follows a route in the routing information generated by the in-vehicle unit mainly using link travel time data received from the infrastructure.
Link	A link is defined as the roadway section between two nodes such as intersections and has directivity with respect to the flow of traffic.
Link travel time	Travel time of a specific link.
Local street	Local streets are all roads other than major roads.
Major roads	Major roads are subject to route guidance by the Interactive CDRG system. These are roads on which management personnel at the traffic control centre consider important such as national highways and other arterial roads with large amounts of traffic.
Multi-mode route guidance	Multi-mode route guidance provides route guidance under the combined operation of the Interactive CDRG, LDRG and SRG systems.
Node	The node refers to the starting point or ending point of a link in a road network. Basically, it is an intersection, a diverging point or a merging point. For convenience's sake, however, any other point may be taken as a node.
OD	The OD information includes both the departure and destination points.
Recommended route	The recommended route is a route calculated by the CDRG infrastructure and sent to the in-vehicle unit.
SRG	Under SRG, the vehicle follows a route generated by the in-vehicle unit using only fixed information such as distance and other data stored in onboard map databases.
Traffic assignment	Traffic assignment is the distribution of traffic in response to the needs of both the traffic situation and the intents of management personnel at the traffic control centre in order to realize a safe, smoothly flowing traffic environment.
Traffic control centre	The traffic control centre comprises necessary buildings, facilities and personnel to effectively execute traffic management and control.
Travel time	Travel time is the actual time required for a vehicle to pass through a specific roadway section in a route.
Uplink	The uplink refers to that portion of a communications link used for the transmission of information from each in-vehicle unit to the infrastructure.

4 The concept of interactive CDRG

4.1 Goals

4.1.1 Promoting Smooth Traffic Flow

a) An interactive CDRG system is intended to secure a more smooth flow of traffic through improved traffic management based on the high-precision prediction of traffic flow generated from OD information collected by the system.

b) In the future when in-vehicle units have become more widespread, the interactive CDRG system will help reduce traffic congestion through traffic assignment.

4.1.2 Securing traffic safety and improving the traffic environment

a) By providing a recommended route based on the driver's destination and preference for travel, the interactive CDRG system assists the driver with probable routing and travel times to his or her destination. Consequently, the system relieves the driver's stress. Moreover, for drivers travelling in an unfamiliar region, interactive CDRG will prevent accidents caused by drivers who are lost or have made a sudden route change.

b) By shortening both travel times and travel distances, the Interactive CDRG system will decrease the probability of accidents and reduce the environmental degradation caused by fuel consumption and noise pollution associated with vehicular traffic.

4.1.3 Promoting onboard unit market

This Technical Report assumes the use of an onboard navigation unit as the interactive terminal for CDRG.

a) Standardizing the message sets brings on benefits both to users, by realizing interchangeable onboard units, and to manufacturers, by standardized production.

b) Standardizing the message sets enables manufacturers to use interchangeable components for the applications that result in expanding the market.

4.2 Basic system functions

a) The system includes facilities for interactive two-way communication between the vehicle and the infrastructure.

b) Using data received from vehicles, traffic management administrators and other sources, the service provider determines a route to the vehicle's destination.

c) This recommended route, determined by the service provider is based on the driver's and/or provider's preference for that trip. Minimizing the predicted travel time to arrive at the driver's destination may be one such preference.

d) In the future when in-vehicle units have become more widespread, the system will determine recommended routes in such a way that its traffic assignments may alleviate traffic congestion.

e) The system will provide service to both vehicles equipped with map databases and those which are not equipped.

f) Portable navigation devices that could be brought into vehicles are not considered in this Technical Report.

4.3 Secondary effects

a) Because the driver can find his or her desired routing recommended by the system, based on predicted travel times and related traffic information, he can choose a route best suited to dynamic traffic conditions. Lacking this capability for prediction, it is difficult for LDRG and SRG to choose routes best suited to dynamic traffic conditions.

b) Because the recommended route is based on the driver's destination and preference for his trip, the amount of data provided to the in-vehicle unit is relatively small and the communication efficiency between the vehicle and the infrastructure can be increased.

c) As a result of b), the system can provide route information for distant destinations with a minimum amount of data that does not require wide bandwidth of the media for communication.

d) Because the infrastructure calculates recommended routes, the computational load on the in-vehicle unit can be reduced.

e) It is unnecessary to update the in-vehicle unit's software for routing calculation.

f) By shortening travel times, personal travel expenses can be reduced with positive economic consequences.

4.4 The possibility of multi-mode route guidance

a) In-vehicle units with map databases can provide more effective route guidance by skilfully combining information provided by the interactive CDRG with LDRG and/or SRG functions of the in-vehicle unit.

b) Both the LDRG and SRG can choose routes based on the local streets information included in the road network data stored in the onboard database. If the in-vehicle unit with LDRG function receives link travel time information from the infrastructure, the in-vehicle unit combines these data with the above road network data to arrive at its routing decision. However, accurate route selection based on prediction is difficult.

c) By providing routing information based on prediction, interactive CDRG is intended to handle links on major roads on which traffic is heavy. Consequently, interactive CDRG is best suited for route guidance on middle- or long-distance routes. For short journeys of only a few kilometres, LDRG or SRG will, in most cases, be more appropriate.

d) By combining the Interactive CDRG with the LDRG or SRG function of the in-vehicle unit, the following system can be realized. From his point of departure until arrival at a major road, a driver uses either LDRG or SRG. Guided by interactive CDRG on the major road, the driver nears his destination where once again the system switches back to either LDRG or SRG and guides him through the local streets to his final destination.

e) With vehicles not equipped with onboard map databases, without relying on LDRG or SRG, the driver must choose his or her own route. Arriving at a major road, the driver chooses his route according to Interactive CDRG using connecting network information. Overall, the same route guidance system operation as described above will be realized.

5 Message set — Contents and format

5.1 Comments on message set

The air interface message sets for the two systems, one based on DSRC and the other on cellular phone, are listed in two columns.

The differences in the message sets for DSRC and cellular phones are summarised in Table 2. The messages which are not listed in Table 2 are essentially the same for both systems. Other than the differences in media we assumed that the same processing style is imposed on the different systems; such as, the routes are processed by links of map data in all systems.

In Table 2, regarding item 2, “localized routing information”, turning point information such as the distance to a turning point is the distance to the nearest turning point on the route from the vehicle. For DSRC this information is effective because the roadside equipment such as a beacon has the location of the turning point and the vehicle position at the time it sends out the distance information to the vehicle. This information is not practical for cellular phone, because the required time for communication through cellular phone, or response time, is much longer than DSRC. Its connection time to the centre is also long and in some cases cannot even connect. When the vehicle receives the distance information to the turning point through cellular phone it may already have passed the turning point minutes or tens of minutes before.

Regarding item 5, this message is intended to send the location information to vehicle from roadside. The location information includes in which lane the vehicle is running. Since the cellular phone system cannot distinguish the vehicle’s running lane, this message does not make sense for the cellular phone system.

5.2 Outline of contents

5.2.1 Overview

The air interface message set is classified into the following five types:

— request for routing from in-vehicle unit (uplink);

— response to in-vehicle unit with map database (downlink);

— response to in-vehicle unit without map database (downlink);

— travel time responded by in-vehicle unit (uplink);

— position report to in-vehicle unit (downlink).

Of these five, the “travel time responded by in-vehicle unit” messages and the “position report to in-vehicle unit” messages are used for route calculations at each infrastructure and the position recognition of its own vehicle by the in-vehicle unit respectively, and enable the execution of more adequate route guidance.

5.2.2 Request for routing from in-vehicle unit (uplink)

These messages consist of the following information to make a request for route guidance from the in-vehicle unit to the infrastructure.

Routing constraint information: restrictive conditions for the provision of routing information such as vehicle type, the availability of any toll road, whether or not the vehicle is equipped with an onboard map database, etc.

Origin-destination designation information: information on the origin (departure point) and destination to be designated by the in-vehicle unit. With the beacon-based CDRG system, origin designation is not required because the beacon installation point is always assumed to be the origin for the destination designated by the in-vehicle unit.

5.2.3 Response to in-vehicle unit with map database (downlink)

These messages consist of the following information to be returned by the infrastructure in response to the request for routing information from the in-vehicle unit equipped with an onboard map database.

Repeat of request for information: the same information as the request for routing information received from the in-vehicle unit is repeated by the infrastructure so that the in-vehicle unit can confirm whether the response information from the infrastructure is in response to its request.

System status: information on the version number of link database in use by the infrastructure, the cause of any system failure when routing information is not properly transmitted, and the cause of any other service failure. The causes of system failures include system (CPU) down and the designation of an origin that is not always necessary and a destination not included in the link database, whereas the causes of other service failures include that the vehicle's current position is outside the service area of the system, no response to the requested information can be processed because static information stored in the beacon is being updated, and the system cannot determine any recommended route due to particular traffic problems.

Size of each route-specific information: data size of route-specific information on each route. This information is provided for the in-vehicle unit to find the first storage location of route-specific information on each route within the message set.

Route-specific information: information specific to each recommended route as follows.

— Route characteristics information for route selection: information to indicate the characteristics of each recommended route. This information is used by the in-vehicle unit (or the driver) for judgment on which of the two or more recommended routes should be selected. This information is provided with respect to each route and includes information related to the quality (or completeness) of routing information such as the provided predicted travel time information or path information is up to the destination or an en route point, information related to the quality of the route itself such as the availability of any toll road, etc., and information related to the travelling efficiency of the vehicle such as predicted travel time, distance, the number of left and/or right turns, etc.

— Infrastructure-localized routing information: information on detailed route guidance in the vicinity of the vehicle such as the distance to the nearest intersection, the recommended turning direction at the intersection, the number of lanes on the link (at an approach to the intersection), and the lane recommended for use (at the end of the link).

Route-specific messages: the name of each roadway point to pass through on the recommended route and traffic information such as an accident, congestion, etc. The point name and traffic data are provided in formats to enable text message display and phonetic output at the in-vehicle unit.

Path information: information on a path defined according to the travelling sequence of links comprising the recommended route. These links correspond to the links registered in the onboard map database of the in-vehicle unit. Based on this path information, the in-vehicle unit can display the route on the digital map.

5.2.4 Response to in-vehicle unit without map database (downlink)

These messages consist of the following information to be returned in response to the request for routing from the in-vehicle unit not equipped with any onboard map database:

Repeat of request for information: the same information as the request for routing information received from the in-vehicle unit is repeated by the infrastructure so that the in-vehicle unit can confirm whether the response information from the infrastructure is in response to its request.

System status: information on the version number of link database in use by the infrastructure, the cause of any system failure when routing information is not properly transmitted, and the cause of any other service failure. The causes of system failures include system (CPU) down and the designation of an origin that is not always necessary and a destination not included in the link database, whereas the causes of other service failures include the vehicle's current position is outside the service area of the system, no response to the requested information can be processed because static information stored in the beacon is being updated, and the system cannot determine any recommended route due to particular traffic problems.

Size of each route-specific information: data size of route-specific information on each route. This information is provided for the in-vehicle unit to find the first storage location of route-specific information on each route within the message set.

Route-specific information:

Information specific to each recommended route as follows.

— Route characteristics information for route selection: information to indicate the characteristics of each recommended route. This information is used by the in-vehicle unit (or the driver) for judgment on which of the two or more recommended routes should be selected. This information is provided with respect to each route and includes information related to the quality (or completeness) of routing information such as the provided predicted travel time information or path information up to the destination or an *en route* point, information related to the quality of the route itself such as the availability of any toll road, etc., and information related to the travelling efficiency of the vehicle such as predicted travel time, distance, the number of left and/or right turns, etc.

Route-specific messages: the name of each roadway point to pass through on the recommended route and traffic information such as an accident, congestion, etc. The point name and traffic data are provided in formats to enable text message display and phonetic output at the in-vehicle unit.

Path information for simplified graphic-type output: Path information on the recommended route for simplified graphic-type output: this information includes the distance to an intersection at the end of a link, the name of the intersection, the directions of roadway (link) connections to draw the vicinity of the intersection (on the map screen), the number of lanes, etc. Several intersections ahead from the current position of the vehicle are subject to the provision of this information. The intersection name and other data are provided in formats to enable text message display and phonetic output at the in-vehicle unit.

Path information for text-type output: Path information on the recommended route: this information includes the name of a roadway or street on which to travel until the vehicle arrives at the destination, the name of a roadway/street change point, the distance to the change point and the recommended turning direction at the change point. All roadways/streets and their change points between the current position of the vehicle and its destination are subject to the provision of this information. These data are provided in formats to enable text message display and phonetic output at the in-vehicle unit.

5.2.5 Travel time responded by in-vehicle unit (uplink)

These messages consist of the following travel-time information measured by the in-vehicle unit and transmitted to the centre for route calculations.

Beacon-to-beacon travel time: the travel time between two beacon points measured by the in-vehicle unit only via SRCD.

Database link travel times: the travel time between both ends of a link measured by the in-vehicle unit. Travel-time data on one or more links are transmitted all at once, but these links shall have been registered in the onboard map database of the in-vehicle unit.

5.2.6 Position report to in-vehicle unit (downlink)

These messages consist of the following information on the current position of the vehicle to be notified by the infrastructure to the in-vehicle unit.

Current position information: information on the current position of the vehicle only via DSRC.

Table 2

Item No.	Message	Flow	Via DSRC	Via cellular phone	Reason for difference
2	Localized routing information	Down	Turning point information (the nearest point)	Not defined	It is not practical for cellular phones because: 1 response time to a vehicle is much longer than DSRC; 2 connection time to the centre is also long; sometimes it cannot connect.
4	Beacon-to beacon travel time	Up	Vehicle measured travelling time (from previous beacon)	Not defined	Cellular system has no beacon.
4	Database link travel times	Up	Timer value when arrived at current beacon Timer value when arrived at previous beacon	The same as DSRC except following messages Timer value when arrived at current beacon Timer value when arrived at previous beacon	The same as above.
5	Current position information	Down	Current position code (including current lane number)	Not defined	Cellular system cannot distinguish the running lane of a vehicle.

No	Message	Data Flow	Data fields Comprising the Message	Field Type	Required Field Size	Field Format	No	Data fields Comprising the Message	Field Type	Required Field Size	Field Format
REQUEST FOR ROUTING FROM IN-VEHICLE UNITS											
1	Header	UP	-Message code	I	16	F	1P	-Message code	I	16	F
			-Assigned vehicle ID	I	40	F		-Assigned vehicle ID	I	40	F
	Routing Constraint Information		-Number (N) of constraint code	I	4	F		-Number (N) of constraint code	I	4	F
			IF N=15:					IF N=15:			
			..Routing constraint flags (for example, large-sized car, toll, without map databases)	I	8 (8*N)	F		..Routing constraint flags (for example, large-sized car, toll, without map databases)	I	8 (8*N)	F
			ELSE: {repeated group: N times}	I	8	F		ELSE: {repeated group: N times}	I	8	F
			..Routing constraint code	I	2	F		..Routing constraint code	I	2	F
	Origin-Destination Designation Information		-Origin designation code (0=not designate; 1=Standard Location Reference)		(72)			-Origin designation code (0=not designate; 1=Standard Location Reference)		(72)	
			IF 1:	I	64	F		IF 1:	I	64	F
			..Standard location reference for a point (1)	I	8	F		..Standard location reference for a point (1)	I	8	F
			..Offset from reference point (20 meter resolution)	I	3	F		..Offset from reference point (20 meter resolution)	I	3	F
			-Destination designation code (1=Standard Location Reference; 2=Zones; 3=Area Specific Location Code: Type A, B, C, D)	I	64	F		-Destination designation code (1=Standard Location Reference; 2=Zones; 3=Area Specific Location Code: Type A, B, C, D)	I	64	F
			IF1: Standard location reference for a point (1)	I	64	F		IF1: Standard location reference for a point (1)	I	64	F
			IF 2: Zones (Standard location reference for an area (1))	I	(34) 20	F		IF 2: Zones (Standard location reference for an area (1))	I	(34) 20	F
			IF 3A: Uniquely Designated Links (requesting route to designated link):	I	2	F		IF 3A: Uniquely Designated Links (requesting route to designated link):	I	2	F
			..Code for area in which link is located	I	12	F		..Code for area in which link is located	I	12	F
			..Code for type of road (general or limited access)					..Code for type of road (general or limited access)			
			..Link number					..Link number			
			IF 3B: Selectively Designated Links (requesting whichever is better of two : one is route to designated link and the other,	I	(34) 20	F		IF 3B: Selectively Designated Links (requesting whichever is better of two : one is route to designated link and the	I	(34) 20	F

No	Message	Data Flow	Data fields Comprising the Message	Field Type	Required Field Size	Field Format	No	Data fields Comprising the Message	Field Type	Required Field Size	Field Format
			route with link which is in opposite direction to designated link and taken	I	2	F		other, route with link which is in opposite direction to designated link and taken	I	2	F
			as destination):	I	12	F		as destination):	I	12	F
			..Code for area in which link is located		(34)			..Code for area in which link is located		(34)	
			..Code for type of road (general or limited access)	I	20	F		..Code for type of road (general or limited access)	I	20	F
			..Link number	I	2	F		..Link number	I	2	F
			IF 3C: Roadway Intersections (Nodes):	I	12	F		IF 3C: Roadway Intersections (Nodes):	I	12	F
			..Code for area in which node is located		(34)			..Code for area in which node is located		(34)	
			..Code for type of road (general or limited access)	I	20	F		..Code for type of road (general or limited access)	I	20	F
			..Link number (any link to be connected to Node)	I	14	F		..Link number (any link to be connected to Node)	I	14	F
			IF 3D: Zones within a larger area:					IF 3D: Zones within a larger area:			
			..Code for area in which zone is located					..Code for area in which zone is located			
			..Zone number					..Zone number			
			RESPONSE TO IN-VEHICLE UNIT WITH MAP DATABASE								
2	Header	DOWN	-Message code	I	16	F	2P	-Message code	I	16	F
			-Assigned vehicle ID	I	20	F		-Assigned vehicle ID	I	20	F
	Repeat of Request for Routing		-Number (N) of constraint code	I	4	F		-Number (N) of constraint code	I	4	F
			IF N = 15:					IF N = 15:			
			..Routing constraint flags (for example, large-sized car, toll, without map databases)	I	8	F		..Routing constraint flags (for example, large-sized car, toll, without map databases)	I	8	F
			ELSE: {repeated group: N times}		(8*N)			ELSE: {repeated group: N times}		(8*N)	
			..Routing constraint code	I	8	F		..Routing constraint code	I	8	F
			-Origin designation code (0 = not designate; 1= Standard Location Reference)	I	2	F		-Origin designation code (0 = not designate; 1= Standard Location Reference)	1	2	F
			IF 1:		(72)			IF 1:		(72)	
			..Standard location reference for a point (1)		64	F		..Standard location reference for a point (1)	I	64	F
			..Offset from reference point (20 meter resolution)	I	8	F		..Offset from reference point (20 meter resolution)	I	8	F
				I	3	F			I	3	F

No	Message	Data Flow	Data fields Comprising the Message	Field Type	Required Field Size	Field Format	No	Data fields Comprising the Message	Field Type	Required Field Size	Field Format
			-Destination designation code (1=Standard Location Reference; 2=Zones;3=Area Specific Location Code: Type A, B, C, D)	I	64	F		-Destination designation code (1=Standard Location Reference; 2=Zones;3=Area Specific Location Code: Type A, B, C, D)	I	64	F
			IF1: Standard location reference for a point (1)	I	64	F		IF1: Standard location reference for a point (1)	I	64	F
			IF 2: Zones (Standard location reference for an area (1))		(34)			IF 2: Zones (Standard location reference for an area (1))		(34)	
			IF 3A: Uniquely Designated Links (requesting route to designated link):	I	20	F		IF 3A: Uniquely Designated Links (requesting route to designated link):	I	20	F
			..Code for area in which link is located	I	2	F		..Code for area in which link is located	I	2	F
			..Code for type of road (general or limited access)	I	12	F		..Code for type of road (general or limited access)	I	12	F
			..Link number	I				..Link number	I		
			IF 3B: Selectively Designated Links (requesting whichever is better of two: one is route to designated link and the other, route with link which is in opposite direction to designated link and taken as destination):		(34)			IF 3B: Selectively Designated Links (requesting whichever is better of two: one is route to designated link and the other, route with link which is in opposite direction to designated link and taken as destination):		(34)	
			..Code for area in which link is located	I	20	F		..Code for area in which link is located	I	20	F
			..Code for type of road (general or limited access)	I	2	F		..Code for type of road (general or limited access)	I	2	F
			..Link number	I	12	F		..Link number	I	12	F
			IF 3C: Roadway Intersections (Nodes):		(34)			IF 3C: Roadway Intersections (Nodes):		(34)	
			..Code for area in which node is located	I	20	F		..Code for area in which node is located	I	20	F
			..Code for type of road (general or limited access)	I	2	F		..Code for type of road (general or limited access)	I	2	F
			..Link number (any link to be connected to Node)	I	12	F		..Link number (any link to be connected to Node)	I	12	F
			IF 3D: Zones within a larger area:		(34)			IF 3D: Zones within a larger area:		(34)	
			..Code for area in which zone is located	I	20	F		..Code for area in which zone is located	I	20	F
			..Zone number	I	14	F		..Zone number	I	14	F
	System Status		- Central link database version		32	F		- Central link database version	I	32	F
			- System predicament code (1=Route calc inoperative (system down); 2=Origin not designated; 3=Destination not included in link database)	I	8	F		- System predicament code (1=Route calc inoperative (system down); 2=Origin not designated; 3=Destination not included in link database)	I	8	F
					3	F			I	3	F

No	Message	Data Flow	Data fields Comprising the Message	Field Type	Required Field Size	Field Format	No	Data fields Comprising the Message	Field Type	Required Field Size	Field Format
			-Service predicament code (1=Veh position outside service area; 2=Static data being updating ; 3=particular traffic problems)	I	(8*N1) 8	F		-Service predicament code (1=Veh position outside service area; 2=Static data being updating ; 3=particular traffic problems)	I	(8*N1) 8	F
	Size of Each Route-Specific Information		-Number (N1) of route-specific information groups {repeated group: N1 times} -Route-specific information data size : C bytes	I	7	F		-Number (N1) of route-specific information groups {repeated group: N1 times} -Route-specific information data size : C bytes	I	7	F
	Route-Specific Information		{repeated group: N1 times}					{repeated group: N1 times}			
	Route characteristics information for route selection		-Route information flags		(41)			-Route information flags		(41)	
			..Travel time completeness (travel time to destination or en route point)	I	1	F		..Travel time completeness (travel time to destination or en route point)	I	1	F
				I	20	F			I	20	F
			..Path completeness (path to destination or en route point)	I	20	F		..Path completeness (path to destination or en route point)	I	20	F
				I							F
			..Toll road (whether route includes any toll road)	I	8	F		..Toll road (whether route includes any toll road)	I	8	F
			..etc.		(16*N 2)			..etc.		(16*N 2)	
			- Predicted route travel time information		16	F		- Predicted route travel time information	I	16	F
			..Travel time presentation flag	I				..Travel time presentation flag			
			..Most probable expected travel time		(24)			..Most probable expected travel time			
			..Maximum predicted travel time		8	F		..Maximum predicted travel time	I		
			- Route length	I	4	F		- Route length	I		
				I	4	F			I		
			-Number (N2) of additional route specific information	I	8	F		-Number (N2) of additional route specific information	I	4	F
			{repeated groups: N2 times}	I				{repeated groups: N2 times}			
			..Additional route-specific information (for example, number of right or left turns)		8	F		..Additional route-specific information (for example, number of right or left turns)	I	8	F
				I	8	F			I	8	F
	Localized routing information		-Turning point information (the nearest point)	I	8*D	V			A	8*D	V
			..Distance to turning point	A	8*E	V			A	8*E	V
				A							

No	Message	Data Flow	Data fields Comprising the Message	Field Type	Required Field Size	Field Format	No	Data fields Comprising the Message	Field Type	Required Field Size	Field Format
			..Recommended turning code		4	F			I	4	F
			..Number of lanes on the link	I							
			..Recommended lane at end of link								
			- Number (N3) of road points provided that		8	F		- Number (N3) of road points provided that	I	8	F
			will be passed on the route	I	8	F		will be passed on the route	I	8	F
			{repeated group: N3 times}	I				{repeated group: N3 times}			
			..Field size of road point name for display: D bytes	I	8	F		..Field size of road point name for display: D bytes	I	8	F
			..Field size of road point name for phonetic output: E bytes	A	8*F 8*G	V V		..Field size of road point name for phonetic output: E bytes	A	8*F 8*G	V V
			..Road point name for display	A	2	F		..Road point name for display	I	2	F
			..Road point name for phonetic output	I				..Road point name for phonetic output			
	Route-specific messages		-Number (N4) of route-specific traffic information groups	L	8 (64*N 5)	F		-Number (N4) of route-specific traffic information groups	I	8 (64*N 5)	F
			{repeated group: N4 times}					{repeated group: N4 times}			
			..Information sentence number	I	64	F		..Information sentence number	I	64	F
			..Field size of Inserted characters for display: F bytes	I	8	F		..Field size of Inserted characters for display: F bytes	I	8	F
			..Field size of Inserted characters for phonetic output: G bytes		20	F		..Field size of Inserted characters for phonetic output: G bytes	I	20	F
			..Inserted characters for display	I	8	F		..Inserted characters for display	I	8	F
			..Inserted characters for phonetic output	I				..Inserted characters for phonetic output			
					8	F			I	8	F
	Path information		-Path specific route code (0 = Random Links; 1 = Numerically Ordered Set of Links)	I	2	F		-Path specific route code (0 = Random Links; 1 = Numerically Ordered Set of Links)	I	2	F
			IF 0: Number (N5) of links remaining in the Route	I	2 12	F F		IF 0: Number (N5) of links remaining in the Route	I	2 12	F F
			{repeated group: N5 times}	I				{repeated group: N5 times}			
			…Route link ID's (standard location reference (1))					…Route link ID's (standard location reference (1))			
			IF 1: Number (N6) of areas through which the vehicle passes					IF 1: Number (N6) of areas through which the vehicle passes			
			{repeated group: N6 times}					{repeated group: N6 times}			
			…Area code					…Area code			
			…Number (N7) of sets of ordered links					…Number (N7) of sets of ordered links			

No	Message	Data Flow	Data fields Comprising the Message	Field Type	Required Field Size	Field Format	No	Data fields Comprising the Message	Field Type	Required Field Size	Field Format
			{repeated group: N7 times} ….Number of consecutive links ….Link layer code (0=standard; 1=”superlinks”) ….Code for type of road ….Starting link number					{repeated group: N7 times} ….Number of consecutive links ….Link layer code (0=standard; 1=”superlinks”) ….Code for type of road ….Starting link number			
RESPONSE TO IN-VEHICLE UNIT WITHOUT MAP DATABASE											
3	Header	DOWN	-Message code	I	16	F	3P	-Message code	I	16	F
			-Assigned vehicle ID	I	40	F		-Assigned vehicle ID	I	40	F
	Repeat of Request for Routing		-Number (N) of constraint code:	I	4	F		-Number (N) of constraint code:	I	4	F
			IF N = 15:					IF N = 15:			
			..Routing constraint flags (for example, large-sizedcar, toll, without map databases)	I	8 (8*N)	F		..Routing constraint flags (for example, large-sizedcar, toll, without map databases)	I	8 (8*N)	F
			ELSE: {repeated group: N times}	I	8	F		ELSE: {repeated group: N times}	I	8	F
			..Routing constraint code	I	2	F		..Routing constraint code	I	2	F
			-Origin designation code (0 = Not Designate; 1= Standard Location Reference)		(72)			-Origin designation code (0 = Not Designate; 1= Standard Location Reference)		(72)	
			IF 1:	I	64	F		IF 1:	I	64	F
			..Standard location reference for a point (1)	I	8	F		..Standard location reference for a point (1)	I	8	F
			..Offset from reference point (20 meter resolution)	I	3	F		..Offset from reference point (20 meter resolution)	I	3	F
			-Destination designation code (1=Standard Location Reference; 2=Zones;3-Area Specific Location Code: Type A, B, C, D)	I	64	F		-Destination designation code (1=Standard Location Reference; 2=Zones;3-Area Specific Location Code: Type A, B, C, D)	I	64	F
			IF 1: Standard location reference for a point (1)	I	64 (34)	F		IF 1: Standard location reference for a point (1)	I	64 (34)	F
			IF 2: Zones (Standard location reference for an area (1))	I	20 2	F F		IF 2: Zones (Standard location reference for an area (1))	I	20 2	F F
			IF 3A: Uniquely Designated Links (requesting route to designated link):	I	12	F		IF 3A: Uniquely Designated Links (requesting route to designated link):	I	12	F
			..Code for area in which link is located					..Code for area in which link is located			
			..Code for type of road (general or limited access)					..Code for type of road (general or limited access)			

No	Message	Data Flow	Data fields Comprising the Message	Field Type	Required Field Size	Field Format	No	Data fields Comprising the Message	Field Type	Required Field Size	Field Format
			..Link number		(34)			..Link number			
			IF 3B: Selectively Designated Links (requesting whichever is better of two: one	I	20	F		IF 3B: Selectively Designated Links (requesting whichever is better of two: one		(34)	
			is route to designated link and the other,	I	2	F		is route to designated link and the other,	I	20	F
			route with link which is in opposite					route with link which is in opposite	I	2	F
			direction to designated link and taken as	I	12	F		direction to designated link and taken as			
			destination):		(34)			destination):	I	12	F
			..Code for area in which link is located	I	20	F		..Code for area in which link is located		(34)	
			..Code for type of road (general or limited access)	I	2	F		..Code for type of road (general or limited access)	I	20	F
			..Link number	I	12	F		..Link number	I	2	F
			IF 3C: Roadway Intersections (Nodes):					IF 3C: Roadway Intersections (Nodes):	I	12	F
			..Code for area in which node is located		(34)			..Code for area in which node is located			
			..Code for type of road (general or limited access)		20	F		..Code for type of road (general or limited access)		(34)	
			..Link number (any link to be connected to Node)	I	14	F		..Link number (any link to be connected to Node)	I	20	F
			IF 3D: Zones within a larger area:	I	32	F		IF 3D: Zones within a larger area:	I	14	F
			..Code for area in which zone is located	I	8	F		..Code for area in which zone is located	I	32	F
			..Zone number					..Zone number	I	8	F
			-Central link database version	I	8	F		-Central link database version			
			-System predicament code (1=Route calc CPU inoperative (system down); 2=Origin not designated; 3=Destination not included in link database)	I	3 (8*N1)	F		-System predicament code (1=Route calc CPU inoperative (system down); 2=origin not designated; 3=Destination not included in link database)	I	8	F
	System Status		-Service predicament code (1=Veh position outside service area; 2=Static data being updating; 3=Particular traffic problems)	I	8	F		-Service predicament code (1=Veh position outside service area; 2=Static data being updating; 3=Particular traffic problems)	I	3 (8*N1)	F
	Size of Each Route-Specific Information		-Number (N1) of route-specific information groups {repeated group: N1 times}	I	7	F		-Number (N1) of route-specific information groups {repeated group: N1 times}	I	8	F
			-Route-specific information data size: C bytes					-Route-specific information data size: C bytes	I	7	F

No	Message	Data Flow	Data fields Comprising the Message	Field Type	Required Field Size	Field Format	No	Data fields Comprising the Message	Field Type	Required Field Size	Field Format
	Route characteristics Information for route selection		**{repeated group: N1 times}**		(41)			**{repeated group: N1 times}**		(41)	
			-Route information flags	I	1	F		-Route information flags	I	1	F
			.. Travel time completeness (travel time to destination or en route)	I	20	F		.. Travel time completeness (travel time to destination or en route)	I	20	F
			..Path completeness (path to destination or en route)	I	20	F		..Path completeness (path to destination or en route)	I	20	F
			..Toll road (whether route includes any toll road)	I	8	F		..Toll road (whether route includes any toll road)	I	8	F
			..etc					..etc			
			- Predicted travel time information		(16*N 3)			- Predicted travel time information		(16*N 3)	
			. .Travel time presentation flag	I	16	F		. .Travel time presentation flag	I	16	F
			. .Most probable expected travel time					. .Most probable expected travel time			
			. .Maximum predicted travel time					. .Maximum predicted travel time			
			- Route length	I	8	F		- Route length	I	8	F
			-Number (N2) of additional route specific information	I	8	F		-Number (N2) of additional route specific information	I	8	F
			{repeated group: N2 times}	A	8*D	V		{repeated group: N2 times}	A	8*D	V
			..Additional route-specific information (for example, number of right or left turns)	A	8*E	V		..Additional route-specific information (for example, number of right or left turns)	A	8*E	V
				I	4	F			I	4	F
	Route-specific messages		- Number (N3) of road points provided that will be passed on the route	I	8	F		- Number (N3) of road points provided that will be passed on the route	I	8	F
			{repeated group: N3 times}	I	8	F		{repeated group: N3 times}	I	8	F
			. .Field size of road point name for display: D bytes	I	8	F		. .Field size of road point name for display: D bytes	I	8	F
			. .Field size of road point name for phonetic output: E bytes	A	8*F	V		. .Field size of road point name for phonetic output: E bytes	A	8*F	V
			. .Road point name for display	A	8*G	V		. .Road point name for display	A	8*G	V
			..Road point name for phonetic output					. .Road point name for phonetic output			
			-Number (N4) of route-specific traffic information groups {repeated group: N4 times}	I	8	F		-Number (N4) of route-specific traffic information groups {repeated group: N4 times}	I	8	F
			..Information sentence number	I	8	F		..Information sentence number	I	8	F
			..Field size of Inserted characters for display: F bytes	I	8	F		..Field size of Inserted characters for display: F bytes	I	8	F
			..Field size of Inserted characters for phonetic output: G bytes	A	8*H	V		..Field size of Inserted characters for phonetic output: G bytes	A	8*H	V
			..Inserted characters for display	A	8*I	V		..Inserted characters for display	A	8*I	V
			..Inserted characters for phonetic output					..Inserted characters for phonetic output			

No	Message	Data Flow	Data fields Comprising the Message	Field Type	Required Field Size	Field Format	No	Data fields Comprising the Message	Field Type	Required Field Size	Field Format
	Path information for simplified graphic-type output		- Number (N5) of consecutive links	I	16	F		- Number (N5) of consecutive links	I	16	F
			{repeated group: N5}	I	4	F		{repeated group: N5}	I	4	F
			..Turning point at end of link	I	4	F		..Turning point at end of link	I	4	F
			…Distance to turning point	I	8	F		…Distance to turning point	I	8	F
			…Field size of turning point name for display: H bytes	I	20	F		…Field size of turning point name for display: H bytes	I	20	F
			…Field size of turning point name for Phonetic output: I bytes	I	2	F		…Field size of turning point name for Phonetic output: I bytes	I	12	F
			…Tuning point name for display	I	12	F		…Tuning point name for display	I	8	F
			…Turning point name for phonetic output	I	8	F		…Turning point name for phonetic output	I	8	F
			..Direction code of road connected to the turning point	I	8	F		..Direction code of road connected to the turning point	I	8	F
			..Recommended turning code	I	8	F		..Recommended turning code	I	8	F
			..Number of lanes at end of link	I	8	F		..Number of lanes at end of link	I	8	F
			..Recommended lane at end of link	A	8*J	V		..Recommended lane at end of link	A	8*J	V
			..Area code	A	8*K	V		..Area code	A	8*K	V
			..Code for type of road	I	4	F		..Code for type of road	I	4	F
			..Link number	I	8	F		..Link number	I	8	F
	Path information for text-type output		-Number (N6) of consecutive roadways or streets to destination	I	8	F		-Number (N6) of consecutive roadways or streets to destination	I	8	F
			{repeated droup: N6 times}	I	8	F		{repeated droup: N6 times}	I	8	F
			..Turning point for another roadway/street	A	8*L	V		..Turning point for another roadway/street	A	8*L	V
			…Distance to turning point	A	8*M	V		…Distance to turning point	A	8*M	V
			…Field size of turning point name for display: J bytes					…Field size of turning point name for display: J bytes			
			…Field size of turning point name for phonetic output: K bytes					…Field size of turning point name for phonetic output: K bytes			
			…Tuning point name for display					…Tuning point name for display			
			…Turning point name for phonetic output					…Turning point name for phonetic output			
			…Recommend turning code					…Recommend turning code			
			. .Consecutive roadway/street name					. .Consecutive roadway/street name			
			…Field size of consecutive roadway/street name for display: L bytes					…Field size of consecutive roadway/street name for display: L bytes			
			…Field size of consecutive					…Field size of consecutive			

No	Message	Data Flow	Data fields Comprising the Message	Field Type	Required Field Size	Field Format	No	Data fields Comprising the Message	Field Type	Required Field Size	Field Format
			roadway/street name for phonetic output: M bytes …Consecutive roadway/street name for display …Consecutive roadway/street name for phonetic output					roadway/street name for phonetic output: M bytes …Consecutive roadway/street name for display …Consecutive roadway/street name for phonetic output			
TRAVEL TIME RESPONDED BY IN-VEHICLE UNIT											
4	Header	UP	-Message code	I	16	F	4P	-Message code	I	16	F
			-Assigned vehicle ID	I	40	F		-Assigned vehicle ID	I	40	F
	Beacon-to-Beacon Travel Time		-Vehicle measured traveling time (from previous beacon)		(40)						
			-Beacon Number (Site Identification) for previously passed beacon		(24)						
			..Beacon Controller number	I	8	F					
			..Beacon Location number	I	16	F					
			-Vehicle determined elapsed time between beacons (seconds)	I	16	F					
	Database Link Travel Times		-Timer value when arrived at current beacon	I	16	F					
			-Timer value when arrived at previous beacon	I	16	F					
			-Link database version	I	32	F		-Link database version	I	32	F
			-Number (N1) of information blocks about consecutive links measured by accomplished driving of vehicle {repeated group: N1 times} (Tracing upstream)	I	8	F		-Number (N1) of information blocks about consecutive links measured by accomplished driving of vehicle {repeated group: N1 times} (Tracing upstream)	I	8	F
			- Timer value when finished driving the last link of this block	I	16	F		- Timer value when finished driving the last link of this block	I	16	F
			- Number (N2) of links of this block {repeated group: N2}	I	8	F		- Number (N2) of links of this block {repeated group: N2}	I	8	F
			.. Area distinction flag (current link's area is or isn't distinct from previous link's area)	I	1	F		.. Area distinction flag (current link's area is or isn't distinct from previous link's area)	I	1	F
			.. Code for type of road	I	2	F		.. Code for type of road	I	2	F
			..Link number	I	12	F		..Link number	I	12	F
				I	20	F			I	20	F

No	Message	Data Flow	Data fields Comprising the Message	Field Type	Required Field Size	Field Format	No	Data fields Comprising the Message	Field Type	Required Field Size	Field Format
			. .Area code if distinct from previous link's area . .Travel time (seconds)	I	16	F		. .Area code if distinct from previous link's area . .Travel time (seconds)	I	16	F
POSITION REPORT TO IN-VEHICLE UNIT											
5	Header Current Position Information	DOWN	-Message code -Current position code (1= Standard Location Reference; 2 =Verbal References) IF 1: ..beacon Number (Site Identification) ...Beacon Controller number ...Beacon (L0cation) ID number ..Beacon location ...Standard location reference (1) ...Offset from reference point (1 meter resolution) IF 2: ..Beacon Pair Identification ...Controller number ...First Beacon's ID ...Second Beacon's ID (for information supplied in pairs) ..Beacon Number (Site Identification) ...Beacon controller number ...Extension number (0 = end of repetition) ...Beacon (location) ID number ..Beacon location ...Map version ...Standard location reference for the beacon ...Road type ...Link number ...Field size of road name for display : A bytes ...Field size of road name for phonetic output: B bytes	I I I I I I I I I I I I I I I I I I I I I I I	16 2 (24) 8 16 (80) 64 16 (40) 8 16 16 (1 or 24) 8 1 15 16 64 2 12 8 8 8*A	F F F F F F F F F F F F F F F F F F V					