소프트웨어연구부문
Software
Research Laboratory

SUMO's TraCI Interfaces

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Introduction

- TraCI Interfaces
  - Controls
  - Variables and Methods
    - Value retrieval
    - Change state
  - Subscriptions
  - Generic Accessing
    - Get/Set

- Control-related commands: perform a simulation step, close the connection, reload the simulation.

For the following APIs, the ID is equal to the ID defined in SUMO's input files. Here, you find their general structure.

- Value Retrieval
  - Induction Loop Value Retrieval retrieve information about induction loops
  - Lane Area Detector Value Retrieval retrieve information about lane area detectors
  - Multi-Entry-Exit Detectors Value Retrieval retrieve information about multi-entry/multi-exit detectors
  - Calibrator Value Retrieval retrieve information about calibrators
  - Traffic Lights Value Retrieval retrieve information about traffic lights
  - Lane Value Retrieval retrieve information about lanes
  - Vehicle Value Retrieval retrieve information about vehicles
  - Person Value Retrieval retrieve information about persons
  - Vehicle Type Value Retrieval retrieve information about vehicle types
  - Route Value Retrieval retrieve information about routes
  - Pol Value Retrieval retrieve information about points-of-interest
  - Polygon Value Retrieval retrieve information about polygons
  - BusStop Value Retrieval retrieve information about BusStops
  - Charging Station Value Retrieval retrieve information about charging stations
  - Parking Area Value Retrieval retrieve information about parking areas
  - Overhead Wire Value Retrieval retrieve information about overhead wires
  - Junction Value Retrieval retrieve information about junctions
  - Edge Value Retrieval retrieve information about edges
  - Simulation Value Retrieval retrieve information about the simulation
  - GUI Value Retrieval retrieve information about the simulation visualization
- State Changing
  - Change Lane State change a lane's state
  - Change Traffic Lights State change a traffic lights' state
  - Change Vehicle State change a vehicle's state
  - Change Person State change a persons's state
  - Change Vehicle Type State change a vehicle type's state
  - Change Route State change a route's state
  - Change Pol State change a point-of-interest's state (or add/remove one)
  - Change Polygon State change a polygon's state (or add/remove one)
  - Change Edge State change an edge's state
  - Change Simulation State change the simulation
  - Change GUI State change the simulation visualization
- Subscriptions
  - TraCI/Object Variable Subscription
  - TraCI/Object Context Subscription
- Accessing Generic Parameters

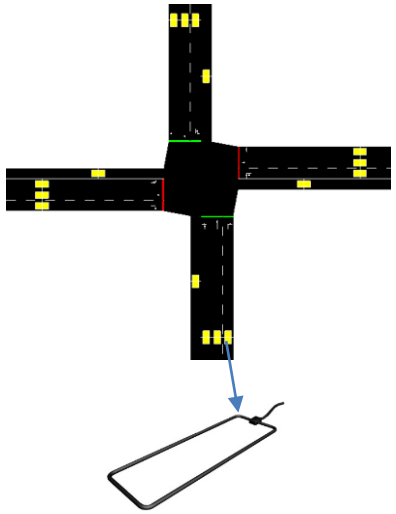
- Full List
  - https://sumo.dlr.de/docs/TraCI.html

Controls

Command	Args	Description
0x00: Get Version		Get an API Version and software version
0x02: Simulation Step	TargetTime [s]	Forces SUMO to perform simulation - If TargetTime is 0: exactly once - Until the given time step is reached
0x7F: Close		Close the connection to any client, stop simulation and shutdown sumo
0x01: Load	Option list	Reload the simulation with the given options
0x03: SetOrder	Number of the client	Give the current client the given position in the execution order

Induction Loop – Value Retrieval

Variable	ValueType	Description	Python Method
id list (0x00)	stringList	List of ids of all induction loops within the scenario	getIDList
count (0x01)	int	Number of induction loops within the scenario	getIDCount
lane ID (0x51)	string	ID of the lane the induction loop is placed at	getLaneID
last step vehicle number (0x10)	int	Number of vehicles that were on the named induction loop within the last step [#]	getLastStepVehicleNumber
last step mean speed (0x11)	double	Mean speed of vehicles that were on the named induction loop within the last step [m/s]	getLastStepMeanSpeed
last step vehicle ids (0x12)	stringList	IDs of vehicles that were on the named induction loop within the last step	getLastStepVehicleIDs
last step occupancy (0x13)	double	Percentage of time the induction loop was occupied by a vehicle [%]	getLastStepOccupancy
last step mean vehicle length (0x15)	double	Mean length of vehicles which were on the induction loop within the last step [m]	getLastStepMeanLength
last step's time since last detection (0x16)	double	Time since last detection [s]	getTimeSinceDetection
last step's vehicle data (0x17)	complex	Several information about vehicles which passed the detector	getVehicleData



루프 검지기(Inductive Loop Detector)는 도로 위에 설치된 루프에 의하여 형성된 감지 영역을 차량이 통과하거나, 정차해 있는 경우 루프의 인덕턴스 변화를 감지하여 통과 또는 존재의 결과를 측정하는 차량 검지기 (매설 깊이: 3~30CM)

```
<additional>
   <inductionLoop id="<ID>" lane="<LANE_ID>" pos="<POSITION_ON_LANE>"
      freq="<AGGREGATION_TIME>" file="<OUTPUT_FILE>" friendlyPos="true"/>
</additional>
```

Induction Loop – Value Retrieval

* last step's vehicle data (0x17)

ubyte	int	<INFORMATION_PACKET>	...	<INFORMATION_PACKET>
"int"	number of information packets	<INFORMATION_PACKET>	...	<INFORMATION_PACKET>

* Information packet

ubyte	string	ubyte	double	ubyte	double	ubyte	double	ubyte	string
"string"	Vehicle ID	"double"	Vehicle Length	"double"	Entry Time [s]	"double"	Leave Time [s]	"string"	**Vehicle Type ID**

실제 루프 검지기는 알 수 없는 정보

- Vehicle Type
  - Routes have vehicle type distributions

```
<routes>
  <vTypeDistribution id="typedist1">
    <vType id="type1" accel="0.8" length="5" maxSpeed="70" probability="0.9"/>
    <vType id="type2" accel="1.8" length="15" maxSpeed="50" probability="0.1"/>
  </vTypeDistribution>
</routes>
```

Attribute Name	Value Type	Default	Description
id	id (string)	-	The name of the vehicle type
accel	float	2.6	The acceleration ability of vehicles of this type (in m/s^2)
decel	float	4.5	The deceleration ability of vehicles of this type (in m/s^2)

Lane Area Detector – Value Retrieval

Variable	ValueType	Description	Python Method
id list (0x00)	stringList	List of ids of all lane area detectors within the scenario	getIDList
count (0x01)	int	Number of lane area detectors within the scenario	getIDCount
position (0x42)	double	Starting position of the detector at it's lane, counted from th e lane's begin, in meters	getPosition
length(0x44)	double	Length of the detector in meters	getLength
lane ID (0x51)	string	ID of the lane the detector is placed at	getLaneID
last step vehicle number (0x10)	int	Number of vehicles that have been within the area detector within the last step [#]	getLastStepVehicleNumber
last step mean speed (0x11)	double	Mean speed of vehicles that have been within the named ar ea detector within the last step [m/s]	getLastStepMeanSpeed
last step vehicle ids (0x12)	stringList	List of ids of vehicles that have been within the detector in t he last step	getLastStepVehicleIDs
last step occupancy (0x13)	int	Percentage of space the detector was occupied by a vehicle [%]	getLastStepOccupancy
last step halting vehicles number (0x14)	int	Number of vehicles which were halting during the last step	getLastStepHaltingNumber
last step jam length in number of vehicles (0x18)	int	Number of vehicles which were halting on the loop during th e last step	getJamLengthVehicle
last step jam length in meters (0x19)	int	Length of the jam in meters	getJamLengthMeters

* A Lane Area Detector is used to capture traffic on an area along a lane or lanes
  → Vehicle tracking camera or CCTV

Multi-Entry-Exit Detector – Value Retrieval

Variable	ValueType	Description	Python Method
id list (0x00)	stringList	List of ids of all multi-entry/multi-exit detectors within the scenario	getIDList
count (0x01)	int	Number of multi-entry/multi-exit detectors within the scenario	getIDCount
last step vehicle number (0x10)	int	Number of vehicles that have been within the named detector within the last step [#];	getLastStepVehicleNumber
last step mean speed (0x11)	double	Mean speed of vehicles that have been within the named detector within the last step [m/s]	getLastStepMeanSpeed
last step vehicle ids (0x12)	stringList	List of ids of vehicles that have been within the named detector in the last step	getLastStepVehicleIDs
last step halting vehicles number (0x14)	int	Number of vehicles which were halting during the last step	getLastStepHaltingNumber

* 하나의 교차로 내에 다중 입구/출구 레인을 검지하는 검지기

```
<additional>
  <entryExitDetector id="<ID>" freq="<AGGREGATION_TIME>" file="<OUTPUT_XMLFILE>"
    timeThreshold="<FLOAT>" speedThreshold="<FLOAT>">
    <detEntry lane="<LANE_ID1>" pos="<POSITION_ON_LANE>" friendlyPos="<BOOL>"/>
    <detEntry lane="<LANE_ID2>" pos="<POSITION_ON_LANE>" friendlyPos="<BOOL>"/>
    <detExit lane="<LANE_ID1>" pos="<POSITION_ON_LANE>" friendlyPos="<BOOL>"/>
    <detExit lane="<LANE_ID3>" pos="<POSITION_ON_LANE>" friendlyPos="<BOOL>"/>
    ... further entries ...
  </entryExitDetector>
</additional>
```

<SUMO's multi entry-exit detector>

Calibrator – Value Retrieval

Variable	ValueType	Description	Python Method
edge ID	string	Edge of this calibrator	getEdgeID
lane ID	string	Lane of this calibrator (if it applies to a single lane)	getLaneID
begin	double	Begin time of the current calibration interval	getBegin
end	double	End time of the current calibration interval	getEnd
insert	double	Number of inserted vehicles in the current calibration interval	getInserted
passed	double	Number of passed vehicles in the current calibration interval	getPassed
removed	double	Number of removed vehicles in the current calibration interval	getRemoved
route ID	string	Route id for the current calibration interval	getRouteID
routeProbe ID	double	RouteProbe id for this calibrator	getRouteProbeID
speed	double	Target speed of the current calibration interval	getSpeed
type ID	string	Type id for the current calibration interval	getTypeID
vTypes	string	List of all types to which the calibrator applies	getVTypes
vehicle per hour	double	Number of vehicles per hour in the current calibration interval	getVehsPerHour
flow	compound	Update or add a calibrator interval	setFlow

Calibrators are trigger-type objects
- Allow the dynamic adaptation of traffic flows, speeds and vehicle parameters (vTypes)
- Used to modify simulation scenario based on induction loop measurements
- Used to model location-based change in driving behavior

RouteProbe detectors
- determine the route distribution for all vehicles that passed an edge in a given interval

* flow

string	double	double	double	string	string	string	string
calibratorID	begin	end	vehsPerHour	speed	typeID	routeID	departLane='first'

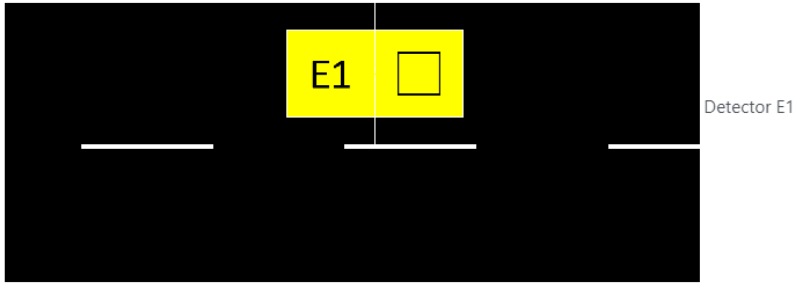
```
<vTypeDistribution id="bad_weather">
   <vType id="car2" speedFactor="0.8" decel="3"/>
   <vType id="truck2" decel="2" tau="1.5" vClass="truck"/>
</vTypeDistribution>
```

```
<calibrator id="c1" lane="middle_0" pos="0" output="detector.xml">
   <flow begin="900" end="1800" route="r1" type="bad_weather"/>
</calibrator>`
```

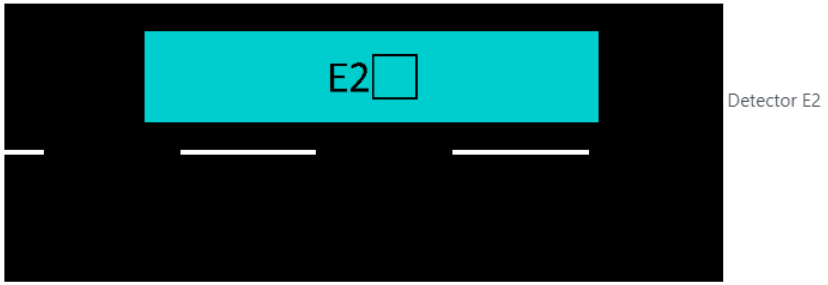
- speedFactor: vehicles' expected multiplicator for lane speed limits
- Tau: the driver's desired (minimum) time headway (차간 거리)

NETEDIT representations of detectors

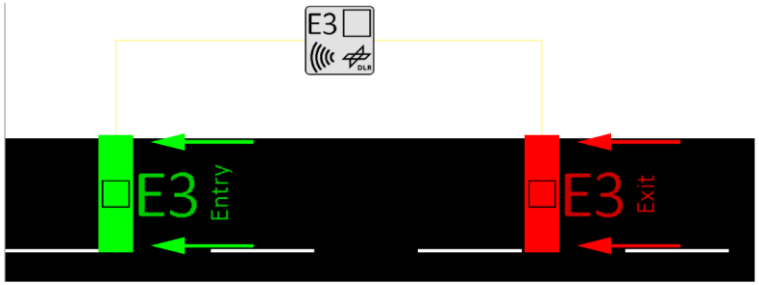
* E1 (induction loop)



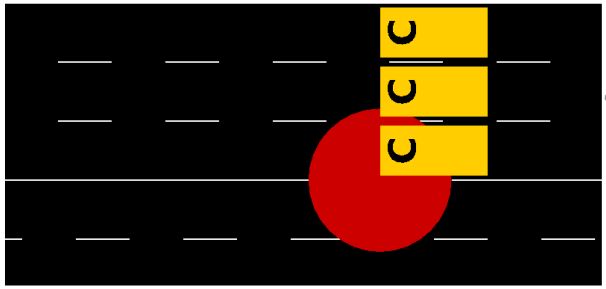
* E2 (lane area)



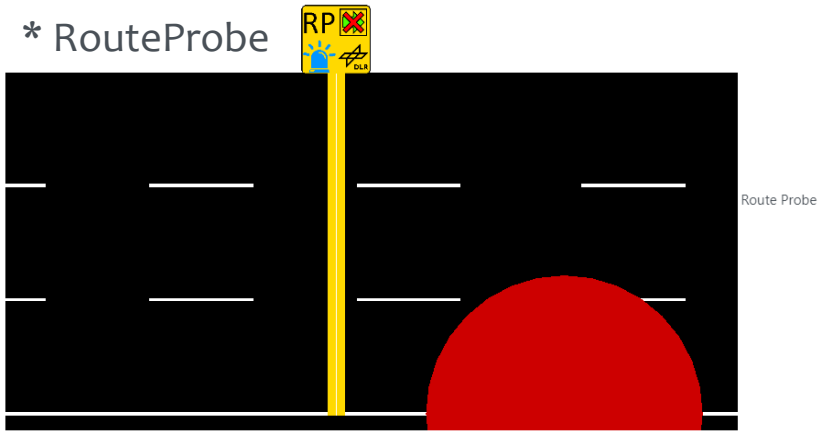
* E3 (multi-entry-exit)



* calibrator



* RouteProbe



real-world equivalent of RouteProbe
- a police stop with questionnaire
- or a look into the database of navigation providers such as TomTom

Traffic Lights – Value Retrieval

Variable	ValueType	Description	Python Method
id list (0x00)	stringList	List of ids of all traffic lights within the scenario	getIDList
count (0x01)	int	Number of traffic lights within the scenario	getIDCount
state (light/priority tuple) (0x20)	string	Traffic light's state as a tuple of light definitions from rRgGyYoO	getRedYellowGreenState
default current phase duration (0x24)	double	Default total duration of the currently active phase in seconds - remaining duration : *(getNextSwitch() - simulation.getTime())* - spent duration : subtract the remaining from the total duration	getPhaseDuration
controlled lanes (0x26)	stringList	List of lanes which are controlled by the named traffic light	getControlledLanes
controlled links (0x27)	compound object	Links controlled by the traffic light	getControlledLinks
current phase (0x28)	int	Index of the current phase in the current program	getPhase
current program (0x29)	string	ID of the current program	getProgram
complete definition (light/priority tuple) (0x2b)	compound object	Complete traffic light program	getCompleteRedYellowGreenDefinition
assumed time of next switch (0x2d)	double	Assumed time (in seconds) at which the traffic light changes the phase	getNextSwitch

* rRgGyYoO: red, green, yellow, off, where lower case letters mean that the stream has to decelerate

Traffic Lights – Value Retrieval

* Traffic light program (both 0x25 and 0x2b)

integer	type + integer	logic	...	logic
Length	Number of logics	logic 1	...	logic n

* Logic

type + string	type + integer	type + compound	type + integer	type + integer	phase	...	phase
SubID	Type	SubParameter	Current phase index	Number of phases	Phase 1	...	Phase n

* Phase

type + double	type + double	type + double	type + string
Duration (in seconds)	MinDuration (in seconds)	MaxDuration (in seconds)	Phase definition

* Controlled links for all signals

integer	controlled links	...	controlled links
Length (number of signals)	links controlled by signal 0	...	links controlled by signal n-1

* Controlled links

int	stringlist	...	stringlist
number of controlled links	link 0	...	link n-1

Traffic Lights – Change State

Variable	ValueType	Description	Python Method
state (light/priority tuple) (0x20)	string	Sets the phase definition to the given	setRedYellowGreenState setLinkState
phase index (0x22)	integer	Sets the current phase of the traffic light to the given	setPhase
program (0x23)	string	Switches the traffic light to the given program	setProgram
phase duration (0x24)	double	Sets the remaining duration of the current phase in seconds	setPhaseDuration
complete program definition (0x2c)	compound	Inserts a completely new program	setCompleteRedYellowGreenDefinition

* Complete program definition (0x2c)

byte	integer	byte	string	byte	integer	byte	compound	byte	integer	byte	integer	<phases>
value type compound	item number	value type string	program ID	value type integer	Type (always 0)	value type compound	Compound Length (always 0!)	value type integer	Phase Index	value type integer	Phase Number	Phases

* Phase

byte	double	byte	double	byte	double	byte	string
value type double	Duration in seconds	value type double	unused	value type double	unused	value type string	State (light/priority-tuple)

Lane – Value Retrieval

Variable	ValueType	Description	Python Method
id list (0x00)	stringList	a list of ids of all lanes within the scenario	getIDList
count (0x01)	int	number of lanes within the scenario	getIDCount
link number (0x30)	ubyte	number of links outgoing from this lane [#]	getLinkNumber
edge id (0x31)	string	id of the edge this lane belongs to	getEdgeID
links (0x33)	compound	descriptions of the links outgoing from this lane [m]	getLinks
allowed vehicle classes (0x34)	stringList	vehicle classes allowed on this lane	getAllowed
disallowed vehicle classes (0x35)	stringList	vehicle classes not allowed on this lane	getDisallowed
length (0x44)	double	length of the named lane [m]	getLength
vmax (0x41)	double	maximum speed allowed on this lane [m/s]	getMaxSpeed
shape (0x4e)	shape	this lane's shape	getShape
width (0x4d)	double	width of the named lane [m]	getWidth
CO2 emissions (id 0x60)	double	Sum of CO2 (이산화탄소) emissions on this lane in mg during this step	getCO2Emission
CO emissions (id 0x61)	double	Sum of CO (일산화탄소) emissions on this lane in mg during this step	getCOEmission
HC emissions (id 0x62)	double	Sum of HC (탄화수소) emissions on this lane in mg during this step	getHCEmission
PMx emissions (id 0x63)	double	Sum of PMx (미세먼지) emissions on this lane in mg during this step	getPMxEmission
NOx emissions (id 0x64)	double	Sum of NOx (질소산화물) emissions on this lane in mg during this step	getNOxEmission
fuel consumption (id 0x65)	double	Sum of fuel consumption on this lane in ml during this step	getFuelConsumption
noise emission (id 0x66)	double	Sum of noise generated on this lane in dBA	getNoiseEmission
electricity consumption (id 0x71)	double	Sum of electricity consumption on this lane in kWh during this step	getElectricityConsumption
last step vehicle number (0x10)	int	Number of vehicles on this lane within the last step	getLastStepVehicleNumber
last step mean speed (0x11)	double	Mean speed of vehicles that were on this lane within the last step [m/s]	getLastStepMeanSpeed
last step vehicle ids (0x12)	stringList	List of ids of vehicles that were on this lane in the last step	getLastStepVehicleIDs
last step occupancy (0x13)	double	Total lengths of vehicles on this lane during the last step - divided by the length of this lane	getLastStepOccupancy
last step mean vehicle length (0x15)	double	Mean length of vehicles which were on this lane in the last step [m]	getLastStepLength
waiting time (0x7a)	double	Waiting time for all vehicles on the lane [s]	getWaitingTime
traveltime (0x5a)	double	Estimated travel time for the last time step on the given lane [s]	getTraveltime
last step halting number (0x14)	int	Total number of halting vehicles for the last time step on the given lane - A speed of less than 0.1 m/s is considered a halt	getLastStepHaltingNumber

Lane – Value Retrieval

* command *links* 0x33 compound response value

integer	type + integer	link	...	link
Length	Number of links	Link 1	...	Link n

* link

type + string	type + string	type + ubyte	type + ubyte	type + ubyte	type + string	type + string	type + double
consecutive not internal lane	consecutive inte rnal lane	has priority (=1) or not (=0)	is opened (=1) or not (=0)	has approaching foe (=1) or not (=0)	(current) state	direction	length [m] - only valid if not using internal lanes

* Extended Value Retrieval

Variable	Request ValueType	Response Value Type	Description	Python Method
foes (0x37)	toLane (string)	stringVector	Returns the list of foe lanes - If **toLane** is a normal road lane that is reachable from the laneID a rgument, the list contains all lanes that are the origin of a connect ion with right-of-way over the connection between **laneID** and **to Lane** - If **toLane** is empty and **laneID** is an internal lane, the list contains a ll internal lanes that intersect with *laneID*	getFoes

Lane – Change State

Variable	ValueType	Description	Python Method
allowed vehicle classes (0x34)	stringList	Sets the given classes as classes allowed on the lane	setAllowed
disallowed vehicle classes (0x35)	stringList	Sets the given classes as classes not allowed on the lane	setDisallowed
length (0x44)	double	Sets the given value as the lane's new length [m]	setLength
vmax (0x41)	double	Sets the given value as the new maximum velocity allowed on the l ane [m/s]	setMaxSpeed

Vehicle – Value Retrieval

Variable	ValueType	Description	Python Method
id list (0x00)	stringList	List of ids of all vehicles currently running within the scenario	getIDList
count (0x01)	int	Number of vehicles currently running within the scenario	getIDCount
speed (0x40)	double	Speed of the named vehicle within the last step [m/s]	getSpeed
lateral speed (0x32)	double	lateral speed of the named vehicle within the last step [m/s]	getLateralSpeed
acceleration (0x72)	double	acceleration in the previous time step [m/s^2]	getAcceleration
position (0x42)	position	position(two doubles) of the named vehicle (center of the front bumper) within the last step [m,m]	getPosition
position 3D (0x39)	position	3D-position(three doubles) of the named vehicle (center of the front bumper) within the last step [m,m,m]	getPosition3D
angle (0x43)	double	angle of the named vehicle within the last step [°]	getAngle
road id (0x50)	string	id of the edge the named vehicle was at within the last step	getRoadID
lane id (0x51)	string	id of the lane the named vehicle was at within the last step	getLaneID
lane index (0x52)	int	index of the lane the named vehicle was at within the last step	getLaneIndex
type id (0x4f)	string	id of the type of the named vehicle	getTypeID
route id (0x53)	string	id of the route of the named vehicle	getRouteID
route index (0x69)	int	index of the current edge within the vehicles route or -1 if the vehicle has not yet departed	getRouteIndex
edges (0x54)	stringList	ids of the edges the vehicle's route is made of	getRoute
color (0x45)	ubyte,ubyte,ubyte,ubyte	vehicle's color (RGBA)	getColor
lane position (0x56)	double	Position of the vehicle along the lane (the distance from the front bumper to the start of the lane in [m])	getLanePosition
distance (0x84)	double	Distance, the vehicle has already driven [m])	getDistance
signal states (0x5b)	int	An integer encoding the state of a vehicle's signals	getSignals
routing mode (0x89)	int	An integer encoding the current routing mode (0: default, 1: aggregated)	getRoutingMode
CO_2 emissions (id 0x60)	double	Vehicle's CO_2 emissions in mg/s during this time step, to get the value for one step multiply with the step length	getCO2Emission
CO emissions (id 0x61)	double	Vehicle's CO emissions in mg/s during this time step, to get the value for one step multiply with the step length	getCOEmission

* Lateral speed: 차량의 조향에 의해 발생되는 횡 방향 이동 속도

Vehicle – Value Retrieval

HC emissions (id 0x62)	double	Vehicle's HC emissions in mg/s during this step	getHCEmission
PMx emissions (id 0x63)	double	Vehicle's PMx emissions in mg/s during this time step	getPMxEmission
NOx emissions (id 0x64)	double	Vehicle's NOx emissions in mg/s during this time step	getNOxEmission
fuel consumption (id 0x65)	double	Vehicle's fuel consumption in ml/s during this time step	getFuelConsumption
noise emission (id 0x66)	double	Noise generated by the vehicle in dBA	getNoiseEmission
electricity consumption (id 0x71)	double	Vehicle's electricity consumption in Wh/s during this time step	getElectricityConsumption
best lanes (id 0xb2)	complex	For each lane on the current edge, the sequences of lanes that would be followed from that lane without lane-change as well as information regarding lane-change desirability are returned	getBestLanes
stop state (id 0xb5)	ubyte	value = 1 * stopped + 2 * parking + 4 * triggered + 8 * containerTriggered + 16 * atBusStop + 32 * atContainerStop + 64 * atChargingStation + 128 * atParkingArea	getStopState isAtBusStop isAtContainerStop isStopped isStoppedParking isStoppedTriggered
length (0x44)	double	length of the vehicles [m]	getLength
vmax (0x41)	double	maximum speed of the vehicle [m/s]	getMaxSpeed
accel (0x46)	double	maximum acceleration possibility of this vehicle [m/s^2]	getAccel
decel (0x47)	double	maximum deceleration possibility of this vehicle [m/s^2]	getDecel
tau (0x48)	double	driver's desired time headway for this vehicle [s]	getTau
sigma (0x5d)	double	driver's imperfection (dawdling) [0,1]	getImperfection
speedFactor (0x5e)	double	road speed multiplier for this vehicle [double]	getSpeedFactor
speedDev (0x5f)	double	deviation of speedFactor for this vehicle [double]	getSpeedDeviation
vClass (0x49)	string	permission class of this vehicle	getVehicleClass
emission_class (0x4a)	string	emission class of this vehicle	getEmissionClass
shape (0x4b)	string	shape class of this vehicle	getShapeClass
minGap (0x4c)	double	offset (gap to front vehicle if halting) of this vehicle [m]	getMinGap

Vehicle – Value Retrieval

width (0x4d)	double	Width of this vehicle [m]	getWidth
height (0xbc)	double	Height of this vehicle [m]	getHeight
person capacity (0x38)	int	Total number of persons that can ride in this vehicle	getPersonCapacity
waiting time (0x7a)	double	Consecutive time in where this vehicle was standing [s] (voluntary stopping is excluded)	getWaitingTime
accumulated waiting time (0x87)	double	Accumulated waiting time [s] within the previous time interval of default length 100s (configurable)	getAccumulatedWaitingTime
next TLS (0x70)	complex	Upcoming traffic lights, along with distance and state	getNextTLS
next stops (0x73)	complex	Returns the list of upcoming stops, each as compound (laneID, endPos, ID, flags, duration, until). If flag 1 is set (stop reached), duration encodes the remaining duration. Negative values indicate being blocked from re-entering traffic after a parking stop	getNextStops
person id list (0x1a)	stringList	List of persons which are riding in this vehicle	getPersonIDList
speed mode (0xb3)	int bitset	how the values set by speed (0x40) and slowdown (0x14) shall be treated	getSpeedMode
lane change mode (0xb6)	int bitset	how lane changing in general and lane changing requests by TraCI are performed	getLaneChangeMode
slope (0x36)	double	slope at the current vehicle position in degrees	getSlope
allowed speed (0xb7)	double	maximum allowed speed on the current lane regarding speed factor in m/s for this vehicle	getAllowedSpeed
line (0xbd)	string	line information of this vehicle	getLine
Person Number(0x67)	int	total number of persons which are riding in this vehicle	getPersonNumber
via edges(0xbe)	stringList	ids of via edges for this vehicle	getVia
speed without TraCI (0xb1)	double	speed that the vehicle would drive if not speed-influencing command such as setSpeed or slowDown was given	getSpeedWithoutTraCI
valid route (0x92)	bool	whether the current vehicle route is connected for the vehicle class of the given vehicle	isRouteValid
lateral lane position (0xb8)	double	lateral position of the vehicle on its current lane measured in m	getLateralLanePosition
max lateral speed (0xba)	double	maximum lateral speed in m/s of this vehicle	getMaxSpeedLat
lateral gap (0xbb)	double	desired lateral gap of this vehicle at 50km/h in m	getMinGapLat
lateral alignment (0xb9)	string	preferred lateral alignment of the vehicle	getLateralAlignment

Vehicle – Value Retrieval

parameter (0x7e)	string	value for the given string parameter	getParameter
action step length (0x7d)	double	current action step length for the vehicle in s	getActionStepLength
last action time (0x7f)	double	time of the last action step in s	getLastActionTime

* next stops (0x73)

byte	int	...
value type *compound*	number of following stop information	stop information

* stop information

byte	string	byte	double	byte	string	byte	integer	byte	double	byte	double
value type *string*	lane-id	value type *double*	endPos	value type *string*	stopping PlaceID	value type *integer*	stopFlags (bit set)	value type *double*	duration in seconds	value type *double*	until in seconds

* best lanes (0xb2)

byte	int	...
value type *compound*	number of following edge information	edge information

* edge information

byte	string	byte	double	byte	double	byte	byte (signed)	byte	byte (unsigned)	byte	stringList
value type *string*	lane-id	value type *double*	length	value type *double*	occupation	value type *byte*	offset to best lane	value type *ubyte*	0: lane may not be used for continuing drive, 1: it may be used	value type *stringlist*	list of best subsequent lanes

Vehicle – Value Retrieval

* Vehicle Signals

Name	Bit
VEH_SIGNAL_BLINKER_RIGHT	0
VEH_SIGNAL_BLINKER_LEFT	1
VEH_SIGNAL_BLINKER_EMERGENCY	2
VEH_SIGNAL_BRAKELIGHT	3
VEH_SIGNAL_FRONTLIGHT	4
VEH_SIGNAL_FOGLIGHT	5
VEH_SIGNAL_HIGHBEAM	6
VEH_SIGNAL_BACKDRIVE	7
VEH_SIGNAL_WIPER	8
VEH_SIGNAL_DOOR_OPEN_LEFT	9
VEH_SIGNAL_DOOR_OPEN_RIGHT	10
VEH_SIGNAL_EMERGENCY_BLUE	11
VEH_SIGNAL_EMERGENCY_RED	12
VEH_SIGNAL_EMERGENCY_YELLOW	13

Vehicle – Value Retrieval

- Travel-time values for routing
  - By default, the route with the least travel time is chosen
  - Travel time depends on the current routing mode

- Routing Mode *traci.constants.ROUTING_MODE_DEFAULT*
  - Order of steps taken to retrieve the travel time for each edge (If a step provides data, this is used, otherwise the next step is attempted)
    1. Vehicle retrieves from it's individual data storage
       - Set and retrieved using methods *change edge travel time information* and *edge travel time information*
    2. Global edge weights loaded using option **--weight-files** are retrieved
    3. Global edge weights (set and retrieved via TraCI)
    4. Minimum travel time (length/allowedSpeed)

- Routing Mode *traci.constants.ROUTING_MODE_AGGREGATED*
  - smoothed travel times computed for the *rerouting device* are used

Vehicle – Value Retrieval Extended

Variable	Request ValueType	Response Value Type	Description	Python Method
edge travel time information (0x58)	compound (time, edgeID)	double	edge travel time for the given time as stored in the vehicle's internal container	getAdaptedTraveltime
edge effort information (0x59)	compound (time, edgeID)	double	edge effort ("edgeID") for the given time as stored in the vehicle's internal container	getEffort
leader (0x68)	double	compound (string, double)	id of the leading vehicle and its distance - Only vehicles ahead on the currently list of *best lanes* are considered	getLeader
distance request (0x83)	compound	double	distance between the current vehicle position and the specified position (for the given distance type)	getDrivingDistance getDrivingDistance2D
change lane information (0x13)	compound	int, int	whether the vehicle could change lanes in the specified direction (right: -1, left: 1. sublane-change within current lane: 0)	getLaneChangeState couldChangeLane wantsAndCouldChangeLane
neighboring vehicles (0x13)	byte	stringList	a list of IDs for neighboring vehicle relevant to lane changing (>1 elements only possible for sublane model)	getNeighbors getLeftFollowers getLeftLeaders getRightFollowers getRightLeaders
followSpeed (0x1c)	compound	double	follow speed computed by the carFollowModel of vehicle	getFollowSpeed
secureGap (0x1e)	compound	double	secure gap computed by the carFollowModel of vehicle	getSecureGap
stopSpeed (0x1e)	compound	double	safe speed for stopping at gap computed by the carFollowModel of vehicle	getStopSpeed

Vehicle – Value Retrieval Extended

* edge travel time information (0x58)

byte	int	byte	double	byte	string
value type *compound*	number of elements (always=2)	value type *double*	requested time (in s)	value type *string*	edge id

* edge effort information (0x59)

byte	int	byte	double	byte	string
value type *compound*	number of elements (a lways=2)	value type *double*	requested time (in s)	value type *string*	edge id

* leader (0x68)

byte	double
value type *double*	minimum look ahead distance (in m)

* next TLS (0x70)

byte	int	byte	int	byte	string	byte	int	byte	double	byte	byte
value typ e *compou nd*	number o f element s	value typ e *integer*	number o f traffic lig ht links ah ead	value typ e *string*	TLS id	value typ e *int*	TLS link in dex	value typ e *double*	distance t o TLS	value typ e *byte*	link state

* change lane information (0x13)

byte	int
value type *compound*	change direction (-1:right, 0:sublane-change within current lane or 1:left)

Vehicle – Device and LaneChangeModel parameters

- Supports using the generic parameter retrieval call
- Supported Device Parameters
  - device.battery.energyConsumed
  - device.battery.energyCharged
  - device.battery.actualBatteryCapacity
  - device.battery.maximumBatteryCapacity
  - device.battery.chargingStationId
  - device.battery.vehicleMass
  - device.person.IDList
  - device.container.IDList
  - device.rerouting.period (returns individual rerouting period in seconds)
  - device.rerouting.edge:EDGE_ID (returns assumed travel time for rerouting where EDGE_ID is the id of a network edge)
  - device.example.customValue1 (return the value of option **--device.example.parameter**)
  - device.example.customValue2 (return the value of vehicle parameter *example*)
  - device.example.meaningOfLife (return 42)
  - has.DEVICENAME.device (returns "true" or "false" depending on whether a device with DEVICENAME is equipped)
- Supported LaneChangeModel Parameters
  - laneChangeModel.<ATTRNAME>
    - <ATTRNAME> : one of the parameters supported by the laneChangeModel of the vehicle
      - i.e. *lcStrategic*)

Vehicle – Change State

Variable	ValueType	Description	Python Method
stop (0x12)	compound (string, double, byte, double)	Lets the vehicle stop at the given edge, at the given position and lane - Vehicle will stop for the given duration - Setting the duration to 0 cancels an existing stop	setStop setBusStop setContainerStop setChargingStationStop setParkingAreaStop
change lane (0x13)	compound (byte, double)	Forces a lane change to the lane with the given index - Lane will be chosen for the given amount of time (in seconds)	changeLane
change sublane (0x15)	double (lateral distance)	Forces a lateral change by the given amount - negative values indicate changing to the right, positive to the left	changeSublane
slow down (0x14)	compound (double, double)	Changes the speed smoothly to the given value over the given amount of time in seconds - can also be used to increase speed	slowDown
resume (0x19)	compound ()	Resumes from a stop	resume
change target (0x31)	string (destination edge id)	Vehicle's destination edge is set to the given - Route is rebuilt	changeTarget
speed (0x40)	double (new speed)	Sets the vehicle speed to the given value - The speed will be followed according to the current speed mode	setSpeed
color (0x45)	ubyte,ubyte,ubyte,ubyte (RGBA)	Sets the vehicle's color	setColor
change route by id (0x53)	string (route id)	Assigns the named route to the vehicle - a) the named route exists - b) it starts on the edge the vehicle is currently at	setRouteID
change route (0x57)	stringList (ids of edges to pass)	Assigns the list of edges as the vehicle's new route - First edge given is the one the vehicle is currently at	setRoute
reroute parking area (0xc2)	string (parking area id)	Changes the next parking area in parkingAreaID - updates the vehicle route - preserve consistency in case of passengers/containers on board	rerouteParkingArea
change edge travel time information (0x58)	compound (begin time, end time, edgeID, value)	Inserts the information about the travel time (in seconds) of edge "edgeID" valid from begin time to end time (in seconds) into the vehicle's internal edge weights container	setAdaptedTraveltime

Vehicle – Change State

change edge effort information (0x59)	compound (begin time, end time, edgeID, value)	Inserts the information about the effort of edge "edgeID" valid from begin time to end time (in seconds) into the vehicle's internal edge weights container	setEffort
signal states (0x5b)	int	Sets a new state of signal	setSignals
routing mode (0x89)	int	Sets the routing mode (0: default, 1: aggregated)	setRoutingMode
move to (0x5c)	compound (lane ID, position along lane)	Moves the vehicle to a new position along the current route	moveTo
move to XY (0xb4)	compound (edgeID, laneIndex, x, y, angle, keepRoute)	Moves the vehicle to a new position after normal vehicle movements have taken place	moveToXY
reroute (compute new route) by travel time (0x90)	compound (<empty>)	Computes a new route to the current destination that minimizes travel time - Use several Simulation/Routing#Travel-time_values_for_routing - Replaces the current route by the found	rerouteTraveltime
reroute (compute new route) by effort (0x91)	compound (<empty>)	Computes a new route using the vehicle's internal and the global edge effort information	rerouteEffort
speed mode (0xb3)	int bitset	Sets how the values set by speed (0x40) and slowdown (0x14) shall be treated	setSpeedMode
speed factor (0x5e)	double	Sets the vehicle's speed factor to the given value	setSpeedFactor
max speed (0x41)	double	Sets the vehicle's maximum speed to the given value	setMaxSpeed
lane change mode (0xb6)	int bitset	Sets how lane changing in general and lane changing requests by TraCI are performed	setLaneChangeMode
update bestLanes (0x6a)		Updates internal data structures for strategic lane choice (e.g. after modifying access permissions)	updateBestLanes
add (0x85)	complex	Adds the defined vehicle	add (alias addFull)
add_legacy (0x80)	complex	Adds the defined vehicle (fewer parameters, obsolete)	addLegacy
remove (0x81)	complex	Removes the defined vehicle	remove
length (0x44)	double	Sets the vehicle's length to the given value	setLength

Vehicle – Change State

vehicle class (0x49)	string	Sets the vehicle's vehicle class to the given value	setVehicleClass
emission class (0x4a)	string	Sets the vehicle's emission class to the given value	setEmissionClass
width (0x4d)	double	Sets the vehicle's width to the given value	setWidth
height (0xbc)	double	Sets the vehicle's height to the given value	setHeight
min gap (0x4c)	double	Sets the vehicle's minimum headway gap to the given value	setMinGap
shape class (0x4b)	string	Sets the vehicle's shape class to the given value	setShapeClass
acceleration (0x46)	double	Sets the vehicle's wished maximum acceleration to the given value	setAccel
deceleration (0x47)	double	Sets the vehicle's wished maximum deceleration to the given value	setDecel
imperfection (0x5d)	double	Sets the vehicle's driver imperfection(딴짓, 주의산만) (sigma) to the given value	setImperfection
tau (0x48)	double	Sets the vehicle's wished headway time (후방 추돌 방지를 위한 안전 거리, 초로 표현, 2초 권장) to the given value	setTau
type (0x4f)	string	Sets the id of the type for the named vehicle	setType
via (0xbe)	stringList	Changes the via edges to the given edges list (to be used during subsequent rerouting calls)	setVia
max lateral speed (0xba)	double	Sets the maximum lateral speed in m/s for this vehicle	setMaxSpeedLat
lateral gap (0xbb)	double	Sets the minimum lateral gap of the vehicle at 50km/h in m	setMinGapLat
lateral alignment (0xb9)	string	Sets the preferred lateral alignment for this vehicle	setLateralAlignment
parameter (0x7e)	string, string	Sets the string value for the given string parameter	setParameter
action step length (0x7d)	double (new action step length), boolean (reset action offset)	Sets the current action step length for the vehicle in s. If the boolean value resetActionOffset is true, an action step is scheduled immediately for the vehicle	setActionStepLength
highlight (0x6c)	highlight specification	Adds a highlight to the vehicle	highlight

* 100km/h = 27.8m/s이면, headway time이 2초이면, 55.6m는 거리를 두어야 후방 추돌 예방 가능

Vehicle – Change State

*** stop (0x12)**

byte	integer	byte	string	byte	double	byte	byte	byte	double	byte	int	byte	double	byte	double
value type *compound*	item number (4 to 7)	value type *string*	Edge ID	value type *double*	end position	value type *byte*	Lane Index	value type *double*	Duration in seconds	value type *byte* (optional)	stop flags	value type *double* (optional)	start position	value type *double* (optional)	until in seconds

* Stop flags are a bitset with the following additive components

- 1 : parking
- 2 : triggered
- 4 : containerTriggered
- 8 : busStop (Edge ID is re-purposed as busStop ID)
- 16 : containerStop (Edge ID is re-purposed as containerStop ID)
- 32 : chargingStation (Edge ID is re-purposed as chargingStation ID)
- 64 : parkingArea (Edge ID is re-purposed as parkingArea ID)

* highlight (0x6c)

- Adds a circle of the specified size and color centered at the vehicle

Vehicle – Change State

* change lane (0x13)

byte	integer	byte	byte	byte	double	byte	byte
value type *compound*	item number (2 or 3)	value type *byte*	Lane Index	value type *double*	Duration in seconds	value type *byte* (optional)	bool for relative lane change

* slow down (0x14)

byte	integer	byte	double	byte	double
value type *compound*	item number (always 2)	value type *double*	Speed	value type *double*	Duration in seconds

* open gap (거리 유지) (0x16)

byte	integer	byte	double	byte	double	byte	double	byte	double	byte	double	byte	string
value type *compound*	item number (4 or 5)	value type *double*	Adapted **time** headway in seconds	value type *double*	Adapted **space** headway in seconds	value type *double*	Duration in seconds	value type *double*	change Rate	value type *double*	maxDecel	value type *string* (optional)	reference vehicle ID

Vehicle – Change State

- speed mode (0xb3)
  - Controls how speeds set with the *setSpeed (0x40)* and *slowDown (0x14)* are used
  - Per default, the vehicle may
    - only drive slower than the speed that is deemed safe by the car following model
    - not exceed the bounds on acceleration and deceleration
    - follow the right-of-way rules (통행 우선 규칙) when approaching an intersection
    - if necessary, brake hard to avoid driving across a red light
  - One can control this behavior using the speed mode (0xb3) command

- lane change mode (0xb6)
  - Discriminates four reasons to change lanes
    - strategic (change lanes to continue the route)
    - cooperative (change in order to allow others to change)
    - speed gain (the other lane allows for faster driving)
    - obligation to drive on the right
  - During each simulation step, the laneChangeModel computes an *internal* request to change the lane or to stay on the current lane

* 통행우선권: 긴급차 > 일반차, 먼저 도착(교차로), 사람 > 차량 (횡단보도),
대로 > 소로, 직진/우회전 > 좌회전

Person – Value Retrieval

Variable	ValueType	Description	Python Method
id list (0x00)	stringList	a list of ids of all persons currently running within the scenario	getIDList
count (0x01)	int	number of persons currently running within the scenario	getIDCount
speed (0x40)	double	speed of the named person within the last step [m/s]	getSpeed
position (0x42)	position	position(two doubles) of the named person within the last step [m,m]	getPosition
position 3D (0x39)	position	3D-position(three doubles) of the named vehicle (center of the front bumper) within the last step [m,m,m]	getPosition3D
angle (0x43)	double	angle of the named person within the last step [°]	getAngle
slope (0x36)	double	slope at the current person position in degrees	getSlope
road id (0x50)	string	id of the edge the named person was at within the last step	getRoadID
type id (0x4f)	string	id of the type of the named person	getTypeID
color (0x45)	ubyte,ubyte,ubyte,ubyte	person's color (RGBA)	getColor
edge position (0x56)	double	position of the person along the edge (in [m])	getLanePosition
length (0x44)	double	length of the persons [m]	getLength
minGap (0x4c)	double	offset (gap to front person if halting) of this person [m]	getMinGap
width (0x4d)	double	width of this person [m]	getWidth
waiting time (0x7a)	double	waiting time [s]	getWaitingTime
next edge (0xc1)	string	next edge on the persons route while it is walking	getNextEdge
remaining stages (0xc2)	int	number of remaining stages for the given person including the current stage	getRemainingStages
vehicle (0xc3)	string	id of the vehicle if the person is in stage driving and has entered a vehicle	getVehicle

Person – Change State

Variable	ValueType	Description	Python Method
add (0x80)	complex see below	Inserts a new person to the simulation at the given edge, position and time (in s). This function should be followed by appending Stages or the person will immediately vanish on departure	add
append stage (0xc4)	complex see below	Appends a stage (stageObject, waiting, walking or driving) to the plan of the given person	appendStage appendDrivingStage appendWaitingStage appendWalkingStage
replace stage (0xcd)	complex see below	Replaces the nth next stage with the given stage object	replaceStage
remove stage (0xc5)	int	Removes the nth next stage	removeStage removeStages
reroute (compute new route) by travel time (0x90)	compound (<empty>)	Computes a new route to the current destination that minimizes travel time - Use several Simulation/Routing#Travel-time_values_for_routing.	rerouteTraveltime
color (0x45)	ubyte,ubyte,ubyte,ubyte (RGBA)	Sets color for person with the given ID	setColor
height (0xbc)	double	Sets the height in m for this person	setHeight
length (0x44)	double	Sets the length in m for the given person	setLength
min gap (0x4c)	double	Sets the offset (gap to front person if halting) for this person	setMinGap
speed (0x5e)	double	Sets the maximum speed in m/s for the named person for subsequent step	setSpeed
type (0x4f)	string (id)	Sets the id of the type for the named person	setType
width (0x4d)	double	Sets the width in m for this person	setWidth

Vehicle Type – Value Retrieval

Variable	ValueType	Description	Python Method
id list (0x00)	stringList	list of ids of currently loaded vehicle types	getIDList
count (0x01)	int	number of currently loaded vehicle types	getIDCount
length (0x44)	double	length of the vehicles of this type [m]	getLength
vmax (0x41)	double	maximum speed of vehicles of this type [m/s]	getMaxSpeed
accel (0x46)	double	maximum acceleration possibility of vehicles of this type [m/s^2]	getAccel
decel (0x47)	double	maximum deceleration possibility of vehicles of this type [m/s^2]	getDecel
tau (0x48)	double	driver's desired time headway for vehicles of this type [s]	getTau
sigma(0x5d)	double	driver's imperfection (dawdling) [0,1]	getImperfection
speedFactor(0x5e)	double	road speed multiplier for drivers of this type [double]	getSpeedFactor
speedDev(0x5f)	double	deviation of speedFactor for drivers of this type [double]	getSpeedDeviation
vclass (0x49)	string	class of vehicles of this type	getVehicleClass
emission_class (0x4a)	string	emission class of vehicles of this type	getEmissionClass
shape (0x4b)	string	shape of vehicles of this type	getShapeClass
minGap (0x4c)	double	offset (gap to front vehicle if halting) of vehicles of this type [m]	getMinGap
width (0x4d)	double	width of vehicles of this type [m]	getWidth
height (0xbc)	double	height of vehicles of this type [m]	getHeight
color (0x45)	byte,byte, byte,byte	color of this type	getColor
max lateral speed (0xba)	double	maximum lateral speed in m/s of this type	getMaxSpeedLat
lateral gap (0xbb)	double	desired lateral gap of this type at 50km/h in m	getMinGapLat
lateral alignment (0xb9)	string	preferred lateral alignment of the type	getLateralAlignment
action step length (0x7d)	double	action step length for the vehicle type in s	getActionStepLength
person capacity (0x38)	int	total number of persons that can ride in a vehicle of this type	getPersonCapacity

Vehicle Type – Change State

Variable	ValueType	Description	Python Method
length (0x44)	double	Sets the vehicle type's length to the given value	setLength
max speed (0x41)	double	Sets the vehicle type's maximum speed to the given value	setMaxSpeed
vehicle class (0x49)	string	Sets the vehicle type's vehicle class to the given value	setVehicleClass
speed factor (0x5e)	double	Sets the vehicle type's speed factor to the given value	setSpeedFactor
speed deviation (0x5f)	double	Sets the vehicle type's speed deviation to the given value	setSpeedDeviation
emission class (0x4a)	string	Sets the vehicle type's emission class to the given value	setEmissionClass
width (0x4d)	double	Sets the vehicle type's width to the given value	setWidth
height(0xbc)	double	Sets the vehicle type's height to the given value	setHeight
min gap (0x4c)	double	Sets the vehicle type's minimum headway gap to the given value	setMinGap
shape class (0x4b)	string	Sets the vehicle type's shape class to the given value	setShapeClass
acceleration (0x46)	double	Sets the vehicle type's wished maximum acceleration to the given value	setAccel
deceleration (0x47)	double	Sets the vehicle type's wished maximum deceleration to the given value	setDecel
imperfection (0x5d)	double	Sets the vehicle type's driver imperfection (sigma) to the given value	setImperfection
tau (0x48)	double	Sets the vehicle type's wished headway time to the given value	setTau
color (0x45)	ubyte,ubyte,ubyte, ubyte (RGBA)	Sets the vehicle type's color	setColor
max lateral speed (0xba)	double	Sets the maximum lateral speed in m/s of this type.	setMaxSpeedLat
lateral gap (0xbb)	double	Sets the minimal lateral gap of this type at 50km/h in m	setMinGapLat
lateral alignment (0xb9)	string	Sets the preferred lateral alignment of the type	setLateralAlignment
copy (0x88)	string	Creates a new vehicle type with the given ID as a duplicate of the original type	copy
action step length (0x7d)	double (new actio n step length), boo lean (reset action o ffset)	Sets the current action step length for the vehicle type in s	setActionStepLength

Route

* Value Retrieval

Variable	ValueType	Description	Python Method
id list (0x00)	stringList	list of ids of all currently loaded routes (the given route ID is ignored)	getIDList
count (0x01)	int	number of currently loaded routes (the given route ID is ignored)	getIDCount
edges (0x54)	stringList	ids of the edges this route covers	getEdges

* Change State

Variable	ValueType	Description	Python Method
add (0x80)	stringList	Adds a new route - the route gets the given id and follows the given edges	add

PoI

* Value Retrieval

Variable	ValueType	Description	Python Method
id list (0x00)	stringList	list of ids of all poi (the given poi ID is ignored)	getIDList
count (0x01)	int	number of pois (the given poi ID is ignored)	getIDCount
type (0x4f)	string	(abstract) type of the poi	getType
color (0x45)	ubyte,ubyte,ubyte,ubyte	color of this poi (rgba)	getColor
position (0x42)	2D-position	position of this poi	getPosition
image file (0x93)	string	path to the image file of the poi	getImageFile
width (0x4d)	float	width for the rendered image file	getWidth
height (0xbc)	float	height for the rendered image file	getHeight
angle (0x43)	float	angle for the rendered image file	getAngle

* Change State

Variable	ValueType	Description	Python Method
type (0x4f)	string	Sets the PoI's type to the given value	setType
color (0x45)	color (ubyte,ubyte,ubyte,ubyte)	Sets the PoI's color to the given value (r,g,b,a) - a(lpha) = 0 means fully transparent	setColor
position (0x42)	Position2D (double, double)	Sets the PoI's position to the given value	setPosition
image file (0x93)	string	Sets the path to the image file of the poi	setImageFile
width (0x4d)	float	Sets the width for the rendered image file	setWidth
height (0xbc)	float	Sets the height for the rendered image file	setHeight
angle (0x43)	float	Sets the angle for the rendered image file	setAngle
ADD (0x80)	PoI-definition, see below	Adds the defined PoI	add
REMOVE (0x81)	int (layer), see below	Removes the defined PoI	remove
highlight (0x6c)	highlight specification, see below	Adds a highlight to the PoI	remove

Polygon

Variable	ValueType	Description	Python Method
id list (0x00)	stringList	list of ids of all polygons (the given polygon ID is ignored)	getIDList
count (0x01)	int	number of polygons (the given polygon ID is ignored)	getIDCount
type (0x4f)	string	(abstract) type of the polygon	getType
color (0x45)	ubyte,ubyte,ubyte,ubyte	color of this polygon (rgba)	getColor
shape (0x4e)	2D-polygon	shape (list of 2D-positions) of this polygon	getShape
filled (0x55)	int	whether this polygon is filled (1) or not (0)	getFilled
lineWidth (0x4d)	double	line width for drawing unfilled polygon	getLineWidth

Polygon – Change State

Variable	ValueType	Description	Python Method
type (0x4f)	string	Sets the polygon's type to the given value	setType
color (0x45)	color (ubyte,ubyte,ubyte,ubyte)	Sets the polygon's color to the given value (r,g,b,a) - please note that a(lpha) = 0 means fully transparent	setColor
shape (0x4e)	2D-polygon	Sets the polygon's shape to the given value	setShape
filled (0x55)	ubyte	Marks that the polygon shall be filled if the value is !=0.	setFilled
lineWidth (0x4d)	double	Sets drawing width for unfilled polygon	setLineWidth
ADD (0x80)	Polygon-definition	Adds the defined Polygon	add
REMOVE (0x81)	int (layer)	Removes the defined Polygon	remove
addDynamics(0x5c)	polygonDynamics definition	Adds the specified dynamics for the Polygon	addDynamics

Bus Stop – Value Retrieval

Variable	ValueType	Description	Python Method
end pos	double	end position of the stop along the lane measured in m	getEndPos
lane ID	string	lane of this stop (if it applies to a single lane)	getLaneID
name	string	name of this stop	getName
person count	integer	total number of waiting persons at the named bus stop	getPersonCount
person ID	stringList	IDs of waiting persons at the named bus stop	getPersonIDs
start pos	double	starting position of the stop along the lane measured in m	getStartPos
vehicle count	integer	total number of vehicles stopped at the named bus stop	getVehicleCount
vehicle ID	stringList	IDs of vehicles stopped at the named bus stop	getVehicleIDs

Charging Station – Value Retrieval

Variable	ValueType	Description	Python Method
end pos	double	end position of the charging station along the lane measured in m	getEndPos
lane ID	string	lane of this charging station (if it applies to a single lane)	getLaneID
name	sting	name of this charging station	getName
start pos	double	starting position of the charging station along the lane measured in m	getStartPos
vehicle count	integer	total number of vehicles stopped at the named charging station	getVehicleCount
vehicle ID	stringList	IDs of vehicles stopped at the named charging station	getVehicleIDs

Parking Area – Value Retrieval

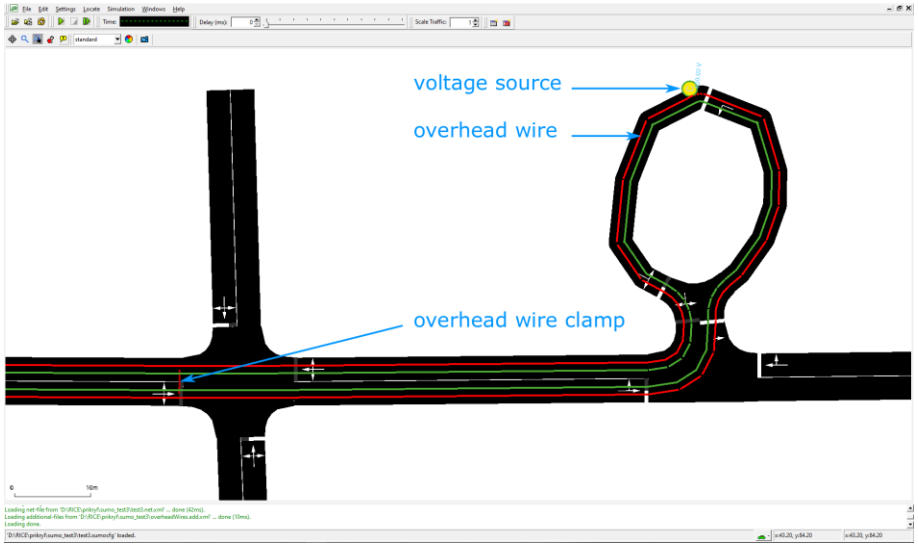
Variable	ValueType	Description	Python Method
end pos	double	end position of the parking area along the lane measured in m	getEndPos
lane ID	string	lane of this parking area (if it applies to a single lane)	getLaneID
name	string	name of this parking area	getName
start pos	double	starting position of the stop along the lane measured in m	getStartPos
vehicle coung	integer	total number of vehicles stopped at the named parking area	getVehicleCount
vehicle ID	stringList	IDs of vehicles stopped at the named parking area	getVehicleIDs

Overhead Wire – Value Retrieval

Variable	ValueType	Description	Python Method
end pos	double	end position of the stop along the lane measured in m	getEndPos
lane ID	string	lane of this calibrator (if it applies to a single lane)	getLaneID
name	string	name of this stop	getName
start pos	double	starting position of the stop along the lane measured in m	getStartPos
vehicle coung	integer	total number of vehicles stopped at the named overhead wire	getVehicleCount
vehicle ID	stringList	the IDs of vehicles stopped at the named overhead wire	getVehicleIDs

Since v1.5.0, SUMO extends the original electric vehicle model with a model that simulates also internal electric parameters of an partial trolleybus

- a vehicle that is being powered by overhead wires
- and has also a battery pack installed, that is being charged from the overhead wires



Junction – Value Retrieval

Variable	ValueType	Description	Python Method
id list (0x00)	stringList	List of ids of all junctions within the scenario	getIDList
count (0x01)	int	Number of junctions within the scenario	getIDCount
position (0x42)	position	Position of the named junction [m,m]	getPosition
shape (0x4e)	2D-polygon	Shape (list of 2D-positions) of the named junction	getShape

Edge – Value Retrieval

Variable	ValueType	Description	Python Method
id list (0x00)	stringList	list of ids of all edges within the scenario	getIDList
count (0x01)	int	number of edges within the scenario	getIDCount
lane number (0x52)	int	number of lanes for the given edge ID	getLaneNumber
street name (0x1b)	string	street name for the given edge ID	getStreetName
current travel time (0x5a)	double	the current travel time (length/mean speed)	getTraveltime
CO2 emissions (id 0x60)	double	Sum of CO2 emissions on this edge in mg during this step	getCO2Emission
CO emissions (id 0x61)	double	Sum of CO emissions on this edge in mg during this step	getCOEmission
HC emissions (id 0x62)	double	Sum of HC emissions on this edge in mg during this step	getHCEmission
PMx emissions (id 0x63)	double	Sum of PMx emissions on this edge in mg during this step	getPMxEmission
NOx emissions (id 0x64)	double	Sum of NOx emissions on this edge in mg during this step	getNOxEmission
fuel consumption (id 0x65)	double	Sum of fuel consumption on this edge in ml during this step	getFuelConsumption
noise emission (id 0x66)	double	Sum of noise generated on this edge in dBA	getNoiseEmission
electricity consumption (id 0x71)	double	Sum of electricity consumption on this edge in kWh during this step	getElectricityConsumption
last step vehicle number (0x10)	int	Number of vehicles on this edge within the last time step	getLastStepVehicleNumber
last step mean speed (0x11)	double	mean speed of vehicles that were on the named edge within the last step [m/s]	getLastStepMeanSpeed
last step vehicle ids (0x12)	stringList	list of ids of vehicles that were on the named edge in the last step - order is from rightmost to leftmost lane and downstream for each lane	getLastStepVehicleIDs
last step occupancy (0x13)	double	percentage of time the edge was occupied by a vehicle [%]	getLastStepOccupancy
last step mean vehicle length (0x15)	double	mean length of vehicles which were on the edge in the last step [m]	getLastStepLength
waiting time (0x7a)	double	sum of the waiting times for all vehicles on the edge [s]	getWaitingTime
last step person ids (0x1a)	stringList	list of ids of persons that were on the named edge in the last simulation step	getLastStepPersonIDs
last step halting number (0x14)	int	total number of halting vehicles for the last step on the given edge - A speed of less than 0.1 m/s is considered a halt	getLastStepHaltingNumber

Edge – Change State

Variable	ValueType	Description	Python Method
change global travel time information (0x58)	compound (begin time, end time, value), see below	Inserts the information about the travel time of the named edge valid from begin time to end time into the global edge weights times container	adaptTraveltime
change global effort information (0x59)	compound (begin time, end time, value), see below	Inserts the information about the effort of the named edge valid from begin time to end time into the global edge weights container	setEffort
change max speed (0x41)		Set a new maximum speed (in m/s) for all lanes of the edge	setMaxSpeed

Simulation – Value Retrieval

Variable	ValueType	Description	Python Method
current simulation time (0x66)	double	current simulation time (in s)	getTime
~~current simulation time (0x70) (deprecated)~~	~~int~~	~~current simulation time (in ms)~~	~~getCurrentTime~~
number of loaded vehicles (id 0x71)	int	number of vehicles which were loaded in this time step	getLoadedNumber
ids of loaded vehicles (id 0x72)	stringList	list of ids of vehicles which were loaded in this time step	getLoadedIDList
number of departed vehicles (id 0x73)	int	number of vehicles which departed (were inserted into the road network) in this time step	getDepartedNumber
ids of departed vehicles (id 0x74)	stringList	list of ids of vehicles which departed (were inserted into the road network) in this time step	getDepartedIDList
number of vehicles that start to teleport (id 0x75)	int	number of vehicles which started to teleport in this time step	getStartingTeleportNumber
ids of vehicles that start to teleport (id 0x76)	stringList	list of ids of vehicles which started to teleport in this time step.	getStartingTeleportIDList
number of vehicles that end being teleported (id 0x77)	int	number of vehicles which ended to be teleported in this time step	getEndingTeleportNumber
ids of vehicles that end being teleported (id 0x78)	stringList	list of ids of vehicles which ended to be teleported in this time step	getEndingTeleportIDList
number of arrived vehicles (id 0x79)	int	number of vehicles which arrived (have reached their destination and are removed from the road network) in this time step	getArrivedNumber
ids of arrived vehicles (id 0x7a)	stringList	list of ids of vehicles which arrived (have reached their destination and are removed from the road network) in this time step	getArrivedIDList
network bounding box (id 0x7c)	2D polygon	lower left and the upper right corner of the bounding box of the simulation network	getNetBoundary
minimum number of vehicles that are still expected to leave the net (id 0x7d)	int	number of vehicles which are in the net plus the ones still waiting to start	getMinExpectedNumber

Simulation – Value Retrieval

number of vehicles that begin a stop (id 0x68)	int	Number of vehicles that halted on a scheduled stop in this time st ep	getStopStartingVehiclesNumber
ids of vehicles that begin a stop (id 0x 69)	stringList	List of ids of vehicles that halted on a scheduled stop in this time step	getStopStartingVehiclesIDList
number of vehicles that end a stop (id 0x6a)	int	number of vehicles that begin to continue their journey, leaving a scheduled stop in this time step	getStopEndingVehiclesNumber
ids of vehicles that end a stop (id 0x6 b)	stringList	list of ids of vehicles that begin to continue their journey, leaving a scheduled stop in this time step	getStopEndingVehiclesIDList
number of vehicles involved in a collisi on (id 0x80)	int	number of vehicles that were involved in a collision in this time st ep	getCollidingVehiclesNumber
ids of vehicles involved in a collision (i d 0x81)	stringList	list of ids of vehicles that were involved in a collision in this time s tep	getCollidingVehiclesIDList
number of vehicles that begin to be p arked (id 0x6c)	int	number of vehicles that enter a parking position in this time step	getParkingStartingVehiclesNumbe r
ids of vehicles that begin to be parked (id 0x6d)	stringList	list of ids of vehicles that enter a parking position in this time step	getParkingStartingVehiclesIDList
number of vehicles that end to be par ked (id 0x6e)	int	number of vehicles that begin to continue their journey, leaving a scheduled parking in this time step	getParkingEndingVehiclesNumber
ids of vehicles that end being parked (id 0x6f)	stringList	list of ids of vehicles that begin to continue their journey, leaving a scheduled parking in this time step	getParkingEndingVehiclesIDList
bus stop waiting (id 0x67)	int	total number of waiting persons at the named bus stop	getBusStopWaiting
bus stop waiting ids (id 0xef)	stringList	ids of waiting persons at the named bus stop	getBusStopWaitingIDList
delta T (id 0x7b)	double	length of one simulation step in seconds	getDeltaT
parameter (0x7e)	string	value for the given string parameter	getParameter

Simulation

* Value Retrieval

Variable	Request ValueType	Response ValueType	Description	Python Method
position conversion (0x82)	compound, see below	Position, as wished	Reads a position information - Returns it converted into the given representation	convert2D convert3D convertGeo convertRoad
distance request (0x83)	compound, see below	double	Reads two positions and an indicator whether the air or the driving distance shall be computed - Returns the according distance	getDistanceRoad getDistance2D
find route (0x86)	compound, see below	compound, see below	Reads origin and destination edge together with some vehicle parameters - Computes the currently fastest driving route for the vehicle (for pedestrians / passengers use find intermodal route).	findRoute
find intermodal route (0x87)	compound, see below	compound, see below	Reads origin and destination position together with usable modes and other person parameters - Computes the currently fastest route for the person using the available modes.	findIntermodalRoute

* Change State

Variable	ValueType	Description	Python Method
clear pending vehicles (0x94)	string *routeID*	Discards all loaded vehicles with a depart time below the current time step which could not be inserted yet	clearPending
save state (0x95)	string *filename*	Saves current simulation state to the given *filename*	saveState

GUI

* Value Retrieval

Variable	ValueType	Description	Python Method
zoom (0xa0)	double	Current zoom level (in %)	getZoom
offset (id 0xa1)	2D-position	Center of the currently visible part of the net	getOffset
schema (id 0xa2)	string	Visualization scheme used (e.g. "standard" or "real world")	getSchema
boundary (id 0xa3)	2D-polygon	Lower left and the upper right corner of the visible network	getBoundary
has view (id 0xa7)	bool	Whether a view with the given ID exists	hasView

* Change State

Variable	ValueType	Description	Python Method
zoom (0xa0)	double	Sets the current zoom level in %	setZoom
offset (0xa1)	2D-position (double, double)	Moves the center of the visible network to the given position	setOffset
schema (0xa2)	string	Sets the visualization scheme (e.g. "standard")	setSchema
boundary (0xa3)	2D-polygon (length 2)	Sets the boundary of the visible network	setBoundary
screenshot (0xa5)	filename (string)	Save a screenshot to the given file	screenshot
track vehicle (0xa6)	vehicle ID (string)	Tracks the given vehicle in the GUI	trackVehicle

Object Variable Subscription

- Variable subscriptions allow to ask once for a set of variables and retrieve them periodically
- Subscription commands are split by the "domain"
  - Command 0xd0: an induction loop (See Induction Loop Value Retrieval for full variables)
  - Command 0xd1: a multi-entry/multi-exit detector
  - Command 0xd2: a traffic light
  - Command 0xd3: a lane
  - Command 0xd4: a vehicle
  - Command 0xd5: a vehicle type
  - Command 0xd6: a route
  - Command 0xd7: a point-of-interest
  - Command 0xd8: a polygon
  - Command 0xd9: a junction
  - Command 0xda: an edge
  - Command 0xdb: the simulation
- Subscription
  - Initiated using a "Subscribe ... Variable" command (0xd0-0xde)
  - Executed after each call of Simulation Step(2) command
  - Returns a "Subscribe ... Variable" response (0xe0-0xee)
- Subscription descheduling
  - E.g. if a variable is vehicle, as soon as the vehicle leaves the simulation

Object Context Subscription

- Context subscriptions allow obtaining of specific values from surrounding objects of a so called "EGO" object
  - Can determine the traffic status around that EGO object
- EGO Objects
  - Inductive loops, lanes, vehicles, PoIs, polygons, junctions, edges
- Context domains
  - For one EGO object, there can be several interesting context domains
  - E.g. a vehicle driving through a city
    - Surrounded by a lot of different and changing vehicles, lanes, junctions, or points-of-interest along the ride
    - Can provide selected variables of those objects that surround the EGO object within a certain range
- Subscription
  - Initiated using a "Subscribe ... Context" command (0x80-0x8e)
  - Executed after each call of Simulation Step(2) command
  - Returns a "Subscribe ... Context" response (0x90-0x9e)
- Subscription descheduling
  - E.g. if EGO is a vehicle, as soon as the vehicle leaves the simulation

Object Context Subscription

* EGO objects

Type	Command ID	Notes
inductive loops	0x80	
lanes	0x83	
vehicles	0x84	
points-of-interest	0x87	
polygons	0x88	
junctions	0x89	
edges	0x8a	

* Context domains

Type	Context Domain ID	Notes
inductive loops	0xa0	
lanes	0xa3	
vehicles	0xa4	
points-of-interest	0xa7	
polygons	0xa8	
junctions	0xa9	
edges	0xaa	

감사합니다