LivingLabBus API introduction

1. Living Lab Bus - goals of the initiative

Living Lab Bus (LLB) is a cooperative approach bringing together different transport ecosystem partners such as traffic operators, research institutes, cities, companies, developer communities etc. with the aim to contribute to sustainable mobility and to increase attractiveness of public transportation. With the LLB venture, where electric busses are provided as a “real world” laboratory, organizations and individuals conforming the “commonly agreed LLB ground rules” are able to innovate, test and develop solutions to achieve sustainable transportation of the future. In addition to the busses and other public transportation vehicles, the LLB system will also cover other transit infrastructure, such as bus stops, depots and terminals.

Goal of the Living Lab Bus (LLB) project (2016- 2018) is to enable this development, testing and demonstration of various transport related services and technologies by using electric buses as a concrete platform in a real use environment. The project studies the implementation, operation and management models for open co-development and test environments and the emerging challenges and solutions for them. Besides sustainable test environments, the focus is on new value networks and business concepts for producing new service solutions together with multiple stakeholders.

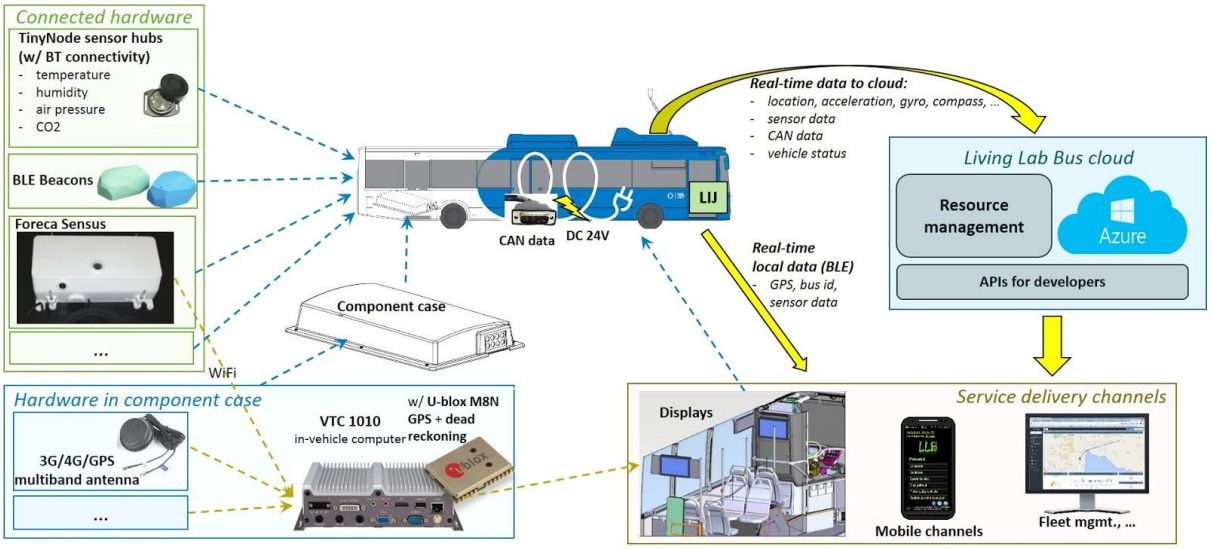
2. LLB as a Platform

The core of the LLB platform is the open mobile edge computing system (OMEC) providing multitenant test environment implemented inside real e-busses. The platform is capable of integrating new software and hardware modules provided by LLB ecosystem partners as well as providing a set of software tools for 3rd party application developers. The extendable OMEC vehicle platform gathers, process and share data from various vehicle- and transport infrastructure by utilizing both wireless and fixed IoT (Internet of Things) sensors. Processed data accumulated in the LLB cloud service is offered via several publicly accessible APIs for enabling new service innovations opportunities both for commercial companies as well as developer communities (like Helsinki Regional Transportation developer community and universities). Public transportation passengers are able to exploit these evolving services via their mobile devices by using an easy to use interfaces.

LLB busses operating in Helsinki City area contain technical environment (see picture below) that makes buses as:

- moving sensor platforms collecting real time electric bus and environmental data from onboard sensors and CAN-bus, transmitting data to the backend cloud service for open data provisioning

- edge computing node controlling data collection and pre-processing, as well as
- on-board and mobile information distribution solutions for providing services and content to passengers and other stakeholders.



More information about Living Lab Bus platform can be found from the project web page: http://livinglabbus.fi/ and overview presentation: http://livinglabbus.fi/LLB_slideset.pdf.

3. LLB Data&API's - Early Access Release Notes

LLB-project is currently offering an early access LLB data interface for developers. The offered LLB data sets, types and formats are, at the time being, in the continuous development and not stabilized yet. We will strive to keep data- and API documentation updated, but a developer should expect changes without a prior notice. Due to the development phase of the system a developer may encounter a lot of bugs and reliability/stability issues. There might be also some service blackouts without any prior warnings occasionally when the software updates and changes are performed. Longer service outages will be announced beforehand in the development support portal.

The aim of this early access release is to provide the potential developers/data utilizers early-stage insight into the features and functionality of the LLB Developer Platform. Furthermore, we seek for feedback from the developer experiments to direct the further work to provide better developer experience. The feedback mechanisms are described in the last section of this memorandum.

4. Features and Data in Early Access

In the early access release data will be gathered from buses 1612, 3008 and 3009 . The bus 1612 is currently operating in real production use in line 23 (route Rautatientori - Alppila - Pasila - Ruskeasuo), the bus 3009 is operating in the line 55 (route Rautatientori - Merihaka - Kalasatama - Kumpula - Koskela) as well as 3008 . The operational status (e.g. on-line) could be checked by using the LLB real time information page : http://llb.vtt.fi/ . During the LLB project the bus fleet will be increased to contain 10 busses operating several different lines depending on the battery charging infrastructure development. The lines will be announced in the updated version of this document as well as in the development portal

All the currently available LLB busses contain following data sources / sensors:

Name	Type	Location
Sensor / TinyNode2	Wireless battery operated environment sensor with 1Hz frequency (temperature, humidity, air pressure, battery level)	front & up (roof)
Sensor / TinyNode3	Wireless battery operated environment sensor with 1Hz frequency (temperature, humidity, air pressure, battery level)	middle & up (1612) Middle & doen (other busses)
Sensor / TinyNode4	Wireless battery operated environment sensor with 1Hz frequency (temperature, humidity, air pressure, battery level)	back & down
CAN	Data collected from vehicle CAN-bus (see section 6 for more detailed info)	
Location	GPS location data (UBlox) with inertia functionality (latitude, longitude, altitude, speed, acceleration,... See section 6 for more detailed info)	Vehicle computing unit
Position	Internal position sensor data collected from the VTC1010 sensors (acceleration, gyro, magnetometer, rotation,... See section 6 for more detailed info)	Vehicle computing unit

In addition to modules installed in busses, same type of TinyNode measurement units equipped with the LORA (a dedicated Low Power Wide Area Network , LPWAN) communication technology will be mounted into a set of bus stops. Locations of these measurement points and available data set will be announced during the autumn 2017 in this page.

5. Data sources

In the early access release the following vehicle data API's are given for open access use: Real Time REST data API, Blob data API and MQTT API.

Real Time REST API is offering a snapshot of the current data available from each bus. This data is updated (in a best effort manner) every second and the updated data is replacing the previous readings available from the given URL (see below).

Blob data API is providing cumulative data collected each day (24 h). Each real time information snapshot is also stored sequentially into files (blobs) according to the defined data types. These data types are:
General data - management information
Sensor data - available from TinyNode sensors
Location data - provided by a GPS sensor
Position data - collected from vehicle computer's internal sensors
CAN data - provided by vehicles internal CAN data sensors
LORA data - collected from certain bus stops (not currently in use, content to be defined)

Each of these data types has several sets of specific attributes that are listed in the chapter 6.

The reference links to this information is referred as:
Hot path = a link (URL) to the real time data (Real time REST API)
Cold path = a link (URL) to the collected cumulative data (Blob data API)

In addition to these web based access, real time data will be also available by using MQTT API, which is announced later.

Note: In addition to LLB offerings, the vehicle data can be also acquired from HSL's Digtransit platform (https://digitransit.fi/en/)

Realtime REST API

- **Brief info:** LLB provides an open REST API for an access to vehicle real-time data. All vehicle sources (sensors, GPS, etc.) publish a message once per second, and developers can access the most recent data through the API.
- **URL**: http://llb.vtt.fi/LLBDataAPI/GetData?busId=BUSID , where
- **BUSID** == four digit bus number from (currently only 1612 are in use)
- **Example**: http://llb.vtt.fi/LLBDataAPI/GetData?busId=1612
- **Data format**: see Section 6.

Blob data API - cumulative data (to be opened in the future)

- **Brief info:** LLB provides an open access to raw data blobs where all the sensor data received from the vehicles (or bus stops) are stored. All vehicle sources (sensors, GPS, etc.) send a message once per second, and the message is stored to blob files in JSON format. The blobs contain data for one day. Developers can download the data that is relevant to them based on mode of transport (currently only busses), bus id (currently only 1612), data type (location, position, sensors, can, etc.) and date.
- **URL**: https://llb.blob.core.windows.net/DATATYPE-BUSID/DATATYPE-BUSID-DATE

- ***DATATYPE***: can, sensor, location, position (see section 7. for usage examples)
- ***BUSID***: 1612 (currently only 1612 is in use)
- ***DATE:*** YYYY_MM_DD
- **Example**: https://llb.blob.core.windows.net/can-1612/can-1612-2017_08_31

MQTT DATA (to be opened in the future)

- **Brief info:** LLB provides an open MQTT API for a publish-subscribe access to vehicle data (MQTT topics) in real-time. All vehicle sources (sensors, GPS, etc.) publish a message once per second, and developers can subscribe to receive the messages that are relevant to them based on mode of transport (currently only busses), bus id (currently only 1612), data type (location, position, sensors, can, etc.).
- **Broker address**: (to be opened soon...)
- **TOPICS**: location, position, sensor, can, status

6. Data Types

General data

Sensor id	**Sensor name**	**Content Description**	**Unit**	**Update interval**	**Example / More info**
BusId	BusID	Id of the bus	int	static	1234
GwId	GatewayId	Id of the gateway device	int	static	99
uts	unixTimeSensor	Time when sensor data was updated	ms	1 Hz	1496657015588
utl	unixTimeLocation	Time when location data was updated	ms	1 Hz	1496657015588
uta	unixTimeStatus	Time when status data was updated	ms	1 Hz	1496657015588
utp	unixTimePosition	Time when position data was updated	ms	1 Hz	"2017/06/05 10:03:35z"
lus	lastUpdatedSensor	Time (UTC) when sensor data was updated	date time	1 Hz	"2017/06/05 10:03:35z"
lul	lastUpdatedLocation	Time (UTC) when location data was updated	date time	1 Hz	"2017/06/05 10:03:35z"

lua	lastUpdatedStatus	Time (UTC) when status data was updated	date time	1 Hz	"2017/06/05 10:03:35z"
lup	lastUpdatedPosition	Time (UTC) when position data was updated	date time	1 Hz	"2017/06/05 10:03:35z"
tsl	timeStampLocation	Local (UTC) GPS timestamp from the vehicle gateway device	date time	1 Hz	"2017-06-05T10:03:35.000Z

Location data:

lat	latitude	Latitude coordinates	decimal degrees	1 Hz	60.18542242
lon	longitude	Longitude coordinates	decimal degrees	1 Hz	24.94245294
alt	altitude	Altitude	m	1 Hz	25.373
eps	error_estimate_speed	Speed error estimate in meter/sec	m/s	1 Hz	0.26
epx	error_estimate_longitude	Estimated Longitude error in meters	decimal degrees	1 Hz	2.118
epv	error_estimate_vertical	Estimated vertical error in meters	decimal degrees	1 Hz	9.89
ept	error_estimate_time	Estimated timestamp error	ms	1 Hz	0.005
spd	speed	Speed of the vehicle	m/s	1 Hz	3.976
clm	climb	Climb (positive) or sink (negative rate, meters per second	m	1 Hz	0.903
trc	track	Course over ground, degrees from true north	m	1 Hz	239.1581
mod	mode	NMEA mode, 0=no mode value yet seen, 1=no fix, 2=2D, 3=3D	int	1 Hz	3

Position data:

tsp	timeStampPosition	local timestamp from the device	date time	1 Hz	"2017-06-05T10:03:35.000Z"
dro	dev_rotation	Device rotation	json	1 Hz	"dro": [{ n_rot_quaternion": [0, 0, 0, 0 }]
gyr	gyro_3d	Gyroscope data	json	1 Hz	"gyr": [{ "in_anglvel_y": 2520, "in_anglvel_x": -980, "in_anglvel_z": -1960 }],
mgn	magn_3d	Magnetometer data	json	1 Hz	"mgn": [{ om_north_magnetic_tilt_cor "in_magn_z": -223360, "in_magn_x": 160640, "in_magn_y": 238400 }]
inc	incli_3d	Gateway/vehicle inclination	json	1 Hz	"inc": [{ "in_incli_x": -103, "in_incli_y": -415, "in_incli_z": 35161 }],
acc	accel_3d	Gateway/vehicle acceleration	json	1 Hz	"acc": [{ "in_accel_z": -1221, "in_accel_y": -5, "in_accel_x": -20 }]

Sensor data:

sep	pressure	measured air pressure (from TinyNode)	kpa	1 Hz	1002.3
sei	index	Index of measured value	int	1 Hz	7207
set	temperature	measured temperature (from TinyNode)	C	1 Hz	19.1
sts	timestamp	Timestamp of the TinyNode value	UTC time date	1 Hz	"2017-06-05T10:03:35.470Z"

seb	battery	measured battery (from TinyNode)	percentage	1 Hz	2.9
sid	sensorId	id of the measured TinyNode value	int	1 Hz	4
srs	rssi	measured RSSI (from TinyNode)	dB-millivolts	1 Hz	77.3
seh	humidity	measured humidity (from TinyNode)	mH2O	1 Hz	56.3

CAN data:

Variable name	Content Description	Unit	Update interval	Example / More info
AIR1_AirCompressorStatus	Status of the air compressor	-	1 Hz	0 = compressor off 1 = compressor running
AIR1_AirSuspensionSupply Press	Air Suspension supply pressure	kPa	1 Hz	8 kPa/bit
AIR1_ParkingAnd_OrTrailer AirPress	Parking brake circuit pressure	kPa	1 Hz	8 kPa/bit
AIR1_PneumaticSupply Press	Pressure of the compressed air tank	kPa	1 Hz	8 kPa/bit
AIR1_ServiceBrakeAirPress Circuit1	Rear axle brake circuit pressure	kPa	1 Hz	8 kPa/bit
AIR1_ServiceBrakeAirPress Circuit2	Front axle brake circuit pressure	kPa	1 Hz	8 kPa/bit
AMB_AmbientAirTemp	Ambient air temperature	°C	1 Hz	
AMB_CabInteriorTemp	Cabin interior temperature	°C	1 Hz	
AS_Alt1Status	Status of the 24V DC/DC converter	-	1 Hz	0 = OFF 1 = ON
BATTERY_Average CellTemp	Average battery cell temperature	°C	1 Hz	
BATTERY_BatteryCurrent	Battery in/out current	A	1 Hz	Negative = discharge Positive = charge Resolution 0.1A
BATTERY_BatteryPower	Battery in/out power	kW	1 Hz	Negative = discharge Positive = charge Resolution 0.1kW
BATTERY_BatteryVoltage	Battery voltage	V	1 Hz	Resolution 0.1V

BATTERY_SOC	Battery State of Charge	%	1 Hz	Resolution 0.5%
CCVS_BrakeSwitch	Brake pedal status	-	1 Hz	0 = pedal not pressed 1 = pedal pressed
CCVS_ParkingBrakeSwitch	Parking brake switch status	-	1 Hz	0 = park brake released 1 = park brake engaged
CCVS_WheelBasedVehicle Speed	Speed measured from the wheels	km/h	1 Hz	
CVW_GrossCombination VehicleWeight	Gross vehicle weight	kg	1 Hz	Measured from the air suspension, not very accurate
DC1_Ramp_WheelChair LiftPos	Wheel chair access ramp status	-	1 Hz	0 = ramp in the bus 1 = ramp out
DC1_PosOfDoors	Status of doors	-	1 Hz	0 = at least 1 door open 1 = last door closing 2 = all doors closed
DD_BatteryLevel	Battery level	%	1 Hz	Resolution 0.4%
DRIVER_Accelerator Position	Accelerator pedal position	%	1 Hz	Resolution 0.5%
DRIVER_BrakePedal Position	Brake pedal position	%	1 Hz	Resolution 0.5%
DRIVER_DriverTorque Request	Driver torque request	%	1 Hz	Positive = torque request Negative = regeneration
DRIVER_RegenControl Position	Regeneration lever position	%	1 Hz	Driver can adjust the strength of the regeneration
DRIVER_SteeringWheel Angle	Steering wheel angle	°	1 Hz	Range = -3276…+3276 degrees (steering wheel can be turned multiple turns) This is not yet working
EEC1_DriversDemand MotorPercentTorque	Driver torque request	%	1 Hz	See DRIVER_DriverTorqueRequest
EEC1_MotorSpeed	Electric motor rpm	rpm	1 Hz	
EEC2_AccelPedalPos1	Accelerator pedal position	%	1 Hz	Resolution 0.4%
EEC2_RoadSpeedLimit Status	Road speed limiter status	-	1 Hz	0 = limiter off 1 = limiter active Not used in Helsinki
EEC2_VhclAcceleration RateLimitStatus	Acceleration limiter status	-	1 Hz	0 = limiter off 1 = limiter active
EFFICIENCY_Efficiency	Momentary energy efficiency	Wh/km	1 Hz	
EFFICIENCY_Efficiency Average	Average energy efficiency	Wh/km	1 Hz	

ENE_AUX1_AirCompressor	Electricity consumed by the air compressor	kWh	1 Hz	
ENE_AUX1_DCDC	Electricity consumed by the DC/DC converter	kWh	1 Hz	
ENE_AUX2_HeatPump	Electricity consumed by the heat pump	kWh	1 Hz	Not including the electricity of the fans; this is included in the DC/DC converter energy
ENE_AUX2_PowerSteering	Electricity consumed by the power steering	kWh	1 Hz	
ENE_MOT_DriveMotor	Electricity consumed by the drive motor	kWh	1 Hz	
ENERGY_TotalChargedEnergy	Total charged energy into the battery	kWh	1 Hz	Includes the regenerated energy
ENERGY_TotalDischargedEnergy	Total discharged energy from the battery	kWh	1 Hz	
ENERGY2_TotalExternalCharge	Total externally charged energy	Ah	1 Hz	
ENERGY2_TotalProcessedAmpHours		Ah	1 Hz	
ET1_MotorCoolantTemp	Motor coolant temperature	°C	1 Hz	
ETC2_TransCurrentGear	Current selected gear	-	1 Hz	0 = neutral 1 = forward -1 = reverse
HOURS_MotorTotalHoursOfOperation	Total hours of operation of the drive motor	h	1 Hz	
MOTOR_AccelerationLimit	Motor acceleration limiter status	-	1 Hz	0 = limiter off 1 = limiter active
MOTOR_MotorTorque	Motor instantaneous torque	Nm	1 Hz	Range 3000…-3000 Nm
MOTOR_MotorTorqueReference	Motor requested torque	Nm	1 Hz	Range 3000…-3000 Nm
MOTOR_SlipLimit	Slip limiter status	-	1 Hz	0 = off 1 = active
MOTOR_Power	Motor instantaneous power	kW	1 Hz	Range 300…-300 kW
MOTOR_SlipPercentage	Measured slip percentage	%	1 Hz	
PWR_AUX_HeatPump	Instantaneous power of heat pump	kW	1 Hz	
PWR_AUX_AirCompressor	Instantaneous power of air compressor	kW	1 Hz	
PWR_AUX_PowerSteering	Instantaneous power of power steering	kW	1 Hz	
PWR_AUX_DCDC	Instantaneous power of DC/DC converter	kW	1 Hz	

STATUS_ChargingType	Battery charging status	-	1 Hz	0 = not charging 1 = charging
TCO1_DirectionIndicator	Drive direction indicator	-	1 Hz	0 = forward 1 = reverse
TCO1_TachographVehicle Speed	Tachograph based vehicle speed	km/h	1 Hz	Resolution 0.004 km/h
TCO1_VehicleMotion	Vehicle motion status	-	1 Hz	0 = vehicle not moving 1 = vehicle moving
TEMPERATURE_Drive Inverter	Drive inverter temperature	°C	1 Hz	
TEMPERATURE_Drive Motor	Drive motor temperature	°C	1 Hz	
VDHR_HghRslutionTotal VehicleDistance	Vehicle total driven distance	m	1 Hz	Resolution 5 m
VI_VehicleIdentification Number	Vehicle ID	ASCII	1 Hz	Currently only sending value "0.1-"
VW_AxleLocation	Vehicle axle weight, axle identifier		0,033 Hz	Indicates the axle of the measured axle weight in VW_AxleWeight Value 15 = front axle Value 31 = rear axle
VW_AxleWeight	Vehicle axle weight	kg	0.033 Hz	Measured axle weight (from air suspension, not very accurate)

7. Usage examples

Example 1. Getting the real time information from the bus 1612.

Request: http://llb.vtt.fi/LLBDataAPI/GetData?busId=1612

(Successful) Response in JSON format:


```
{
        "BusId": 1612,
        "GwId": 10,
        "tsl": "2017-09-18T12:56:21.000Z",
        "lat": 60.203802542,
        "lon": 24.918602306,
        "alt": 29.121,
        "spd": 8.656,
        "eps": 0.54,
        "epx": 0.005,
        "epv": 37.03,
```

```
        "ept": 12.22,
        "clm": -0.081,
        "trc": 151.4996,
        "mod": 3.0,
        "tsp": "2017-09-18T12:56:20.000Z",
        "dro": [{
                "in_rot_quaternion": [0, 0, 0, 0]
        }],
        "acc": [{
                "in_accel_z": -1221,
                "in_accel_y": -5,
                "in_accel_x": -20
        }],
        "inc": [{
                "in_incli_x": -103,
                "in_incli_y": -415,
                "in_incli_z": 35161
        }],
        "mgn": [{
                "in_rot_from_north_magnetic_tilt_comp": 845,
                "in_magn_z": -223360,
                "in_magn_x": 160640,
                "in_magn_y": 238400
        }],
        "gyr": [{
                "in_anglvel_y": 2520,
                "in_anglvel_x": -980,
                "in_anglvel_z": -1960
        }],
        "stt": "null",
        "tmp": 26.8,
        "tmc": 35.0,
        "tmh": 33,
        "tms": 36.0,
        "vol": "in0:+0.71V(min=+1.20V,max=+1.62V)ALARM
in1:+1.36V(min=+3.01V,max=+0.46V)ALARM in2:+2.00V(min=+2.45V,max=+0.85V)ALARM
+3.3V:+3.34V(min=+3.67V,max=+2.23V)ALARM
in4:+2.02V(min=+2.05V,max=+3.05V)ALARM
in5:+2.02V(min=+1.21V,max=+2.47V)in6:+2.23V(min=+2.29V,max=+1.16V)ALARM
3VSB:+3.31V(min=+2.76V,max=+0.84V)ALARM Vbat:+3.19V",
        "fan": "fan1:0RPM(min=0RPM)fan2:0RPM(min=0RPM)fan3:0RPM(min=0RPM)",
        "fil":
"Filesystem;Size;Used;Avail;Use%;Mounted;onudev;914M;0;914M;0%;/devtmpfs;187M;21M
;167M;11%;/run/dev/sda1;28G;9,6G;17G;37%;/tmpfs;934M;204K;934M;1%;/dev/shmtmpfs;5
,0M;4,0K;5,0M;1%;/run/locktmpfs;934M;0;934M;0%;/sys/fs/cgrouptmpfs;187M;28K;187M;1
%;/run/user/108tmpfs;187M;0;187M;0%;/run/user/1000;",
```

```
        "mem":
"total;used;free;shared;buff/cache;availableMem:;1866;215;991;34;659;1453Swap:;1909;0;1
909ip_address=10.42.0.1;195.165.205.171;",
        "tsc": "2017/09/18 03:28:25z",
        "fi/llb/bus/1612/10/can/": {
                "timestamp": "2017-09-18 06:28:25.763",
                "AIR1_AirCompressorStatus": "0",
                "AIR1_AirSuspensionSupplyPress": "808",
                "AIR1_ParkingAnd_OrTrailerAirPress": "808",
                "AIR1_PneumaticSupplyPress": "312",
                "AIR1_ServiceBrakeAirPressCircuit1": "808",
                "AIR1_ServiceBrakeAirPressCircuit2": "808",
                "AMB_AmbientAirTemp": "8.00",
                "AMB_CabInteriorTemp": "18.00",
                "AS_Alt1Status": "0",
                "BATTERY_AverageCellTemp": "24",
                "BATTERY_BatteryCurrent": "-2.90",
                "BATTERY_BatteryPower": "-2.10",
                "BATTERY_BatteryVoltage": "724.30",
                "BATTERY_SOC": "80.00",
                "CCVS_BrakeSwitch": "0",
                "CCVS_ParkingBrakeSwitch": "1",
                "CCVS_WheelBasedVehicleSpeed": "256.00",
                "CVW_GrossCombinationVehicleWeight": "12120",
                "DC1_Ramp_WheelChairLiftPos": "0",
                "DC1_PosOfDoors": "2",
                "DD_BatteryLevel": "80.00",
                "DRIVER_AcceleratorPosition": "0",
                "DRIVER_BrakePedalPosition": "0",
                "DRIVER_DriverTorqueRequest": "0",
                "DRIVER_RegenControlPosition": "0",
                "DRIVER_SteeringWheelAngle": "0.00",
                "EEC1_DriversDemandMotorPercentTorque": "0",
                "EEC1_MotorSpeed": "0",
                "EEC2_AccelPedalPos1": "0",
                "EEC2_RoadSpeedLimitStatus": "0",
                "EEC2_VhclAccelerationRateLimitStatus": "0",
                "EFFICIENCY_Efficiency": "-8",
                "EFFICIENCY_EfficiencyAverage": "-1009",
                "ENE_AUX1_AirCompressor": "1485",
                "ENE_AUX1_DCDC": "5139",
                "ENE_AUX2_HeatPump": "2238",
                "ENE_AUX2_PowerSteering": "408",
                "ENE_MOT_DriveMotor": "21128",
                "ENERGY_TotalChargedEnergy": "45827",
                "ENERGY_TotalDischargedEnergy": "42242",
```

```
        "ENERGY2_TotalExternalCharge": "32962",
        "ENERGY2_TotalProcessedAmpHours": "123777",
        "ET1_MotorCoolantTemp": "60",
        "ETC2_TransCurrentGear": "0",
        "HOURS_MotorTotalHoursOfOperation": "1353.10",
        "MOTOR_AccelerationLimit": "0",
        "MOTOR_MotorTorque": "0",
        "MOTOR_MotorTorqueReference": "0",
        "MOTOR_SlipLimit": "0",
        "MOTOR_Power": "0.00",
        "MOTOR_SlipPercentage": "-100",
        "PWR_AUX_HeatPump": "0.00",
        "PWR_AUX_AirCompressor": "0.00",
        "PWR_AUX_PowerSteering": "0.00",
        "PWR_AUX_DCDC": "0.00",
        "STATUS_ChargingType": "0",
        "TCO1_DirectionIndicator": "0",
        "TCO1_TachographVehicleSpeed": "256.00",
        "TCO1_VehicleMotion": "1",
        "TEMPERATURE_DriveInverter": "27",
        "TEMPERATURE_DriveMotor": "38",
        "VDHR_HghRslutionTotalVehicleDistance": "31134210",
        "VI_VehicleIdentificationNumber": "808333613",
        "VW_AxleLocation": "0",
        "VW_AxleWeight": "4637"
},
"1612_2": {
        "sts_2": "2017/09/18 12:56:13z",
        "gid_2": "10",
        "sep_2": 999.0,
        "set_2": 19.3,
        "seb_2": 2.6,
        "srs_2": 70.2,
        "seh_2": 51.1
},
"1612_3": {
        "sts_3": "2017/09/18 12:54:12z",
        "gid_3": "10",
        "sep_3": 1001.0,
        "set_3": 20.2,
        "seb_3": 2.6,
        "srs_3": 69.4,
        "seh_3": 47.0
},
"1612_4": {
        "sts_4": "2017/09/18 12:56:20z",
```

```
                "gid_4": "10",
                "sep_4": 999.2,
                "set_4": 18.7,
                "seb_4": 2.8,
                "srs_4": 70.6,
                "seh_4": 49.8
        },
        "1612_4490": {
                "sts_4490": "2017/06/15 12:48:30z",
                "gid_4490": "10",
                "sep_4490": 1016.6,
                "set_4490": 29.75,
                "seb_4490": 0.0,
                "srs_4490": -41.0,
                "seh_4490": 19.1
        },
        "1612_4491": {
                "sts_4491": "2017/06/15 12:48:22z",
                "gid_4491": "10",
                "sep_4491": 1015.3,
                "set_4491": 30.44,
                "seb_4491": 0.0,
                "srs_4491": -47.0,
                "seh_4491": 17.44
        },
        "1612_4492": {
                "sts_4492": "2017/06/15 12:48:06z",
                "gid_4492": "10",
                "sep_4492": 1013.5,
                "set_4492": 29.11,
                "seb_4492": 0.0,
                "srs_4492": -45.0,
                "seh_4492": 20.34
        }
}
```


Possible error message: TBD- currently and empty page is returned

Example 2. Getting cumulative data via Bloab data API from the bus 1612, the interesting data type is CAN:

Request:

https://llb.blob.core.windows.net/can-1612/can-1612-2017_09_27

Other alternatives for the request paths:

Sensor data	https://llb.blob.core.windows.net/sensor-1612/sensor-1612-2017_09_27
Location data	https://llb.blob.core.windows.net/location-1612/location-1612-2017_09_27
Position data	https://llb.blob.core.windows.net/position-1612/position-1612-2017_09_27
LORA data	Currently not in use, to be defined

Successful response (for the CAN - request) in the JSON format :


```
"fi/llb/bus/1612/10/can/": {
   "timestamp": "2017-09-27T02:57:50.513Z",
   "AIR1_AirCompressorStatus": "0",
   "AIR1_AirSuspensionSupplyPress": "824",
   "AIR1_ParkingAnd_OrTrailerAirPress": "816",
   "AIR1_PneumaticSupplyPress": "0",
   "AIR1_ServiceBrakeAirPressCircuit1": "816",
   "AIR1_ServiceBrakeAirPressCircuit2": "816",
   "AMB_AmbientAirTemp": "13.00",
   "AMB_CabInteriorTemp": "15.00",
   "AS_Alt1Status": "1",
   "BATTERY_AverageCellTemp": "24",
   "BATTERY_BatteryCurrent": "114.10",
   "BATTERY_BatteryPower": "83.80",
   "BATTERY_BatteryVoltage": "734.40",
   "BATTERY_SOC": "80.50",
   "CCVS_BrakeSwitch": "1",
   "CCVS_ParkingBrakeSwitch": "0",
   "CCVS_WheelBasedVehicleSpeed": "28.79",
   "CVW_GrossCombinationVehicleWeight": "12310",
   "DC1_Ramp_WheelChairLiftPos": "0",
   "DC1_PosOfDoors": "2",
   "DD_BatteryLevel": "80.80",
   "DRIVER_AcceleratorPosition": "0",
   "DRIVER_BrakePedalPosition": "70",
   "DRIVER_DriverTorqueRequest": "-60",
   "DRIVER_RegenControlPosition": "0",
   "DRIVER_SteeringWheelAngle": "0.00",
   "EEC1_DriversDemandMotorPercentTorque": "-60",
```

```
    "EEC1_MotorSpeed": "853",
    "EEC2_AccelPedalPos1": "0",
    "EEC2_RoadSpeedLimitStatus": "0",
    "EEC2_VhclAccelerationRateLimitStatus": "0",
    "EFFICIENCY_Efficiency": "2911",
    "EFFICIENCY_EfficiencyAverage": "-1129",
    "ENE_AUX1_AirCompressor": "1554",
    "ENE_AUX1_DCDC": "5358",
    "ENE_AUX2_HeatPump": "2310",
    "ENE_AUX2_PowerSteering": "427",
    "ENE_MOT_DriveMotor": "22030",
    "ENERGY_TotalChargedEnergy": "47846",
    "ENERGY_TotalDischargedEnergy": "44116",
    "ENERGY2_TotalExternalCharge": "34346",
    "ENERGY2_TotalProcessedAmpHours": "129241",
    "ET1_MotorCoolantTemp": "60",
    "ETC2_TransCurrentGear": "126",
    "HOURS_MotorTotalHoursOfOperation": "1416.35",
    "MOTOR_AccelerationLimit": "0",
    "MOTOR_MotorTorque": "-1045",
    "MOTOR_MotorTorqueReference": "-1202",
    "MOTOR_SlipLimit": "0",
    "MOTOR_Power": "-87.67",
    "MOTOR_SlipPercentage": "-5",
    "PWR_AUX_HeatPump": "2.42",
    "PWR_AUX_AirCompressor": "0.00",
    "PWR_AUX_PowerSteering": "0.59",
    "PWR_AUX_DCDC": "1.96",
    "STATUS_ChargingType": "0",
    "TCO1_DirectionIndicator": "0",
    "TCO1_TachographVehicleSpeed": "28.79",
    "TCO1_VehicleMotion": "1",
    "TEMPERATURE_DriveInverter": "39",
    "TEMPERATURE_DriveMotor": "35",
    "VDHR_HghRslutionTotalVehicleDistance": "32574240",
    "VI_VehicleIdentificationNumber": "808333613",
    "VW_AxleLocation": "1",
    "VW_AxleWeight": "7522"
  }, "fi/llb/bus/1612/10/can/": {
    "timestamp": "2017-09-27T02:57:51.541Z",
    "AIR1_AirCompressorStatus": "0",
    "AIR1_AirSuspensionSupplyPress": "824",
    "AIR1_ParkingAnd_OrTrailerAirPress": "816",
    "AIR1_PneumaticSupplyPress": "0",
    "AIR1_ServiceBrakeAirPressCircuit1": "816",
    "AIR1_ServiceBrakeAirPressCircuit2": "816",
```

"AMB_AmbientAirTemp": "13.00",
"AMB_CabInteriorTemp": "15.00",
"AS_Alt1Status": "1",
"BATTERY_AverageCellTemp": "24",
"BATTERY_BatteryCurrent": "65.20",
"BATTERY_BatteryPower": "47.70",
"BATTERY_BatteryVoltage": "731.50",
"BATTERY_SOC": "80.50",
"CCVS_BrakeSwitch": "1",
"CCVS_ParkingBrakeSwitch": "0",
"CCVS_WheelBasedVehicleSpeed": "24.47",
"CVW_GrossCombinationVehicleWeight": "12340",
"DC1_Ramp_WheelChairLiftPos": "0",
"DC1_PosOfDoors": "2",
"DD_BatteryLevel": "80.80",
"DRIVER_AcceleratorPosition": "0",
"DRIVER_BrakePedalPosition": "59",
"DRIVER_DriverTorqueRequest": "-43",
"DRIVER_RegenControlPosition": "0",
"DRIVER_SteeringWheelAngle": "0.00",
"EEC1_DriversDemandMotorPercentTorque": "-44",
"EEC1_MotorSpeed": "731",
"EEC2_AccelPedalPos1": "0",
"EEC2_RoadSpeedLimitStatus": "0",
"EEC2_VhclAccelerationRateLimitStatus": "0",
"EFFICIENCY_Efficiency": "1895",
"EFFICIENCY_EfficiencyAverage": "-1128",
"ENE_AUX1_AirCompressor": "1554",
"ENE_AUX1_DCDC": "5358",
"ENE_AUX2_HeatPump": "2310",
"ENE_AUX2_PowerSteering": "427",
"ENE_MOT_DriveMotor": "22030",
"ENERGY_TotalChargedEnergy": "47846",
"ENERGY_TotalDischargedEnergy": "44116",
"ENERGY2_TotalExternalCharge": "34346",
"ENERGY2_TotalProcessedAmpHours": "129241",
"ET1_MotorCoolantTemp": "60",
"ETC2_TransCurrentGear": "126",
"HOURS_MotorTotalHoursOfOperation": "1416.35",
"MOTOR_AccelerationLimit": "0",
"MOTOR_MotorTorque": "-695",
"MOTOR_MotorTorqueReference": "-866",
"MOTOR_SlipLimit": "0",
"MOTOR_Power": "-51.62",
"MOTOR_SlipPercentage": "-8",
"PWR_AUX_HeatPump": "1.80",

```
    "PWR_AUX_AirCompressor": "0.00",
    "PWR_AUX_PowerSteering": "0.86",
    "PWR_AUX_DCDC": "2.01",
    "STATUS_ChargingType": "0",
    "TCO1_DirectionIndicator": "0",
    "TCO1_TachographVehicleSpeed": "24.44",
    "TCO1_VehicleMotion": "1",
    "TEMPERATURE_DriveInverter": "39",
    "TEMPERATURE_DriveMotor": "36",
    "VDHR_HghRslutionTotalVehicleDistance": "32574250",
    "VI_VehicleIdentificationNumber": "808333613",
    "VW_AxleLocation": "1",
    "VW_AxleWeight": "7558"
}, "fi/llb/bus/1612/10/can/": {
    "timestamp": "2017-09-27T02:57:52.587Z",
    "AIR1_AirCompressorStatus": "0",
    "AIR1_AirSuspensionSupplyPress": "824",
    "AIR1_ParkingAnd_OrTrailerAirPress": "816",
    "AIR1_PneumaticSupplyPress": "0",
    "AIR1_ServiceBrakeAirPressCircuit1": "816",
    "AIR1_ServiceBrakeAirPressCircuit2": "816",
    "AMB_AmbientAirTemp": "13.00",
    "AMB_CabInteriorTemp": "15.00",
    "AS_Alt1Status": "1",
    "BATTERY_AverageCellTemp": "24",
    "BATTERY_BatteryCurrent": "-14.70",
    "BATTERY_BatteryPower": "-10.70",
    "BATTERY_BatteryVoltage": "727.20",
    "BATTERY_SOC": "80.50",
    "CCVS_BrakeSwitch": "0",
    "CCVS_ParkingBrakeSwitch": "0",
    "CCVS_WheelBasedVehicleSpeed": "22.62",
    "CVW_GrossCombinationVehicleWeight": "12190",
    "DC1_Ramp_WheelChairLiftPos": "0",
    "DC1_PosOfDoors": "2",
    "DD_BatteryLevel": "80.80",
    "DRIVER_AcceleratorPosition": "0",
    "DRIVER_BrakePedalPosition": "0",
    "DRIVER_DriverTorqueRequest": "-1",
    "DRIVER_RegenControlPosition": "0",
    "DRIVER_SteeringWheelAngle": "0.00",
    "EEC1_DriversDemandMotorPercentTorque": "-1",
    "EEC1_MotorSpeed": "669",
    "EEC2_AccelPedalPos1": "0",
    "EEC2_RoadSpeedLimitStatus": "0",
    "EEC2_VhclAccelerationRateLimitStatus": "0",
```

```
    "EFFICIENCY_Efficiency": "-426",
    "EFFICIENCY_EfficiencyAverage": "-1128",
    "ENE_AUX1_AirCompressor": "1554",
    "ENE_AUX1_DCDC": "5358",
    "ENE_AUX2_HeatPump": "2310",
    "ENE_AUX2_PowerSteering": "427",
    "ENE_MOT_DriveMotor": "22030",
    "ENERGY_TotalChargedEnergy": "47847",
    "ENERGY_TotalDischargedEnergy": "44116",
    "ENERGY2_TotalExternalCharge": "34346",
    "ENERGY2_TotalProcessedAmpHours": "129241",
    "ET1_MotorCoolantTemp": "60",
    "ETC2_TransCurrentGear": "126",
    "HOURS_MotorTotalHoursOfOperation": "1416.35",
    "MOTOR_AccelerationLimit": "0",
    "MOTOR_MotorTorque": "54",
    "MOTOR_MotorTorqueReference": "-26",
    "MOTOR_SlipLimit": "0",
    "MOTOR_Power": "4.61",
    "MOTOR_SlipPercentage": "-9",
    "PWR_AUX_HeatPump": "2.16",
    "PWR_AUX_AirCompressor": "0.00",
    "PWR_AUX_PowerSteering": "1.02",
    "PWR_AUX_DCDC": "1.94",
    "STATUS_ChargingType": "0",
    "TCO1_DirectionIndicator": "0",
    "TCO1_TachographVehicleSpeed": "22.51",
    "TCO1_VehicleMotion": "1",
    "TEMPERATURE_DriveInverter": "36",
    "TEMPERATURE_DriveMotor": "36",
    "VDHR_HghRslutionTotalVehicleDistance": "32574260",
    "VI_VehicleIdentificationNumber": "808333613",
    "VW_AxleLocation": "1",
    "VW_AxleWeight": "7506"
}, "fi/llb/bus/1612/10/can/": {
    "timestamp": "2017-09-27T02:57:53.619Z",

    ....
```


Example 3. Usage pattern for MQTT data API

Sending feedback & getting support

The development support is still in the early phase of development. If some questions or suggestions will arise - please use the portal’s feedback channels.