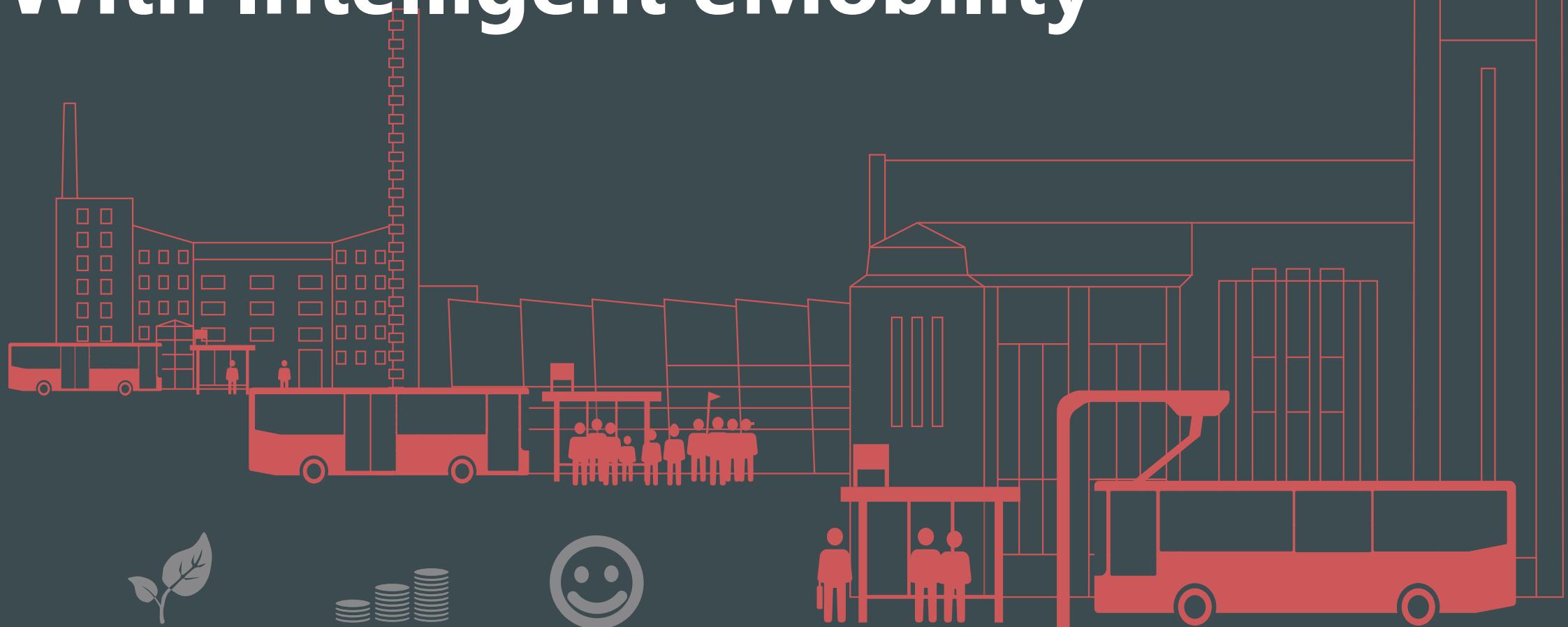


Linker

Intelligent eMobility



Mission – Quality of Life in Cities With Intelligent eMobility



Environment

Economy

Experience

Value Proposition

High Performance

Typical city line 5 km - 20 km
24 / 7 operation
Daily mileage of 350 km
Robust performance also in demanding conditions



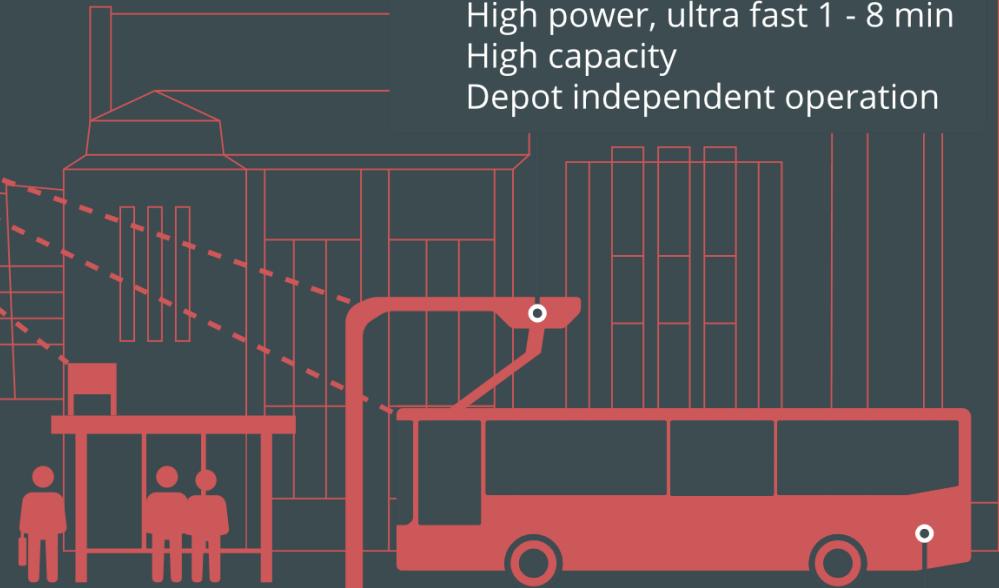
On-line monitoring of fleet

Fleet performance
Charging performance
Fleet management



Opportunity charging

Re-charging at end stops
High power, ultra fast 1 - 8 min
High capacity
Depot independent operation



Lowest operational costs

Lower energy-, battery- and charger cost
Lower maintenance cost
Low cost per km

Improved safety

Safer battery chemistries with reduced risk for thermal runaway
Smaller batteries improve employee safety at depots

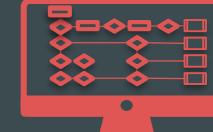
Milestones – Developing Competence



Energy efficiency

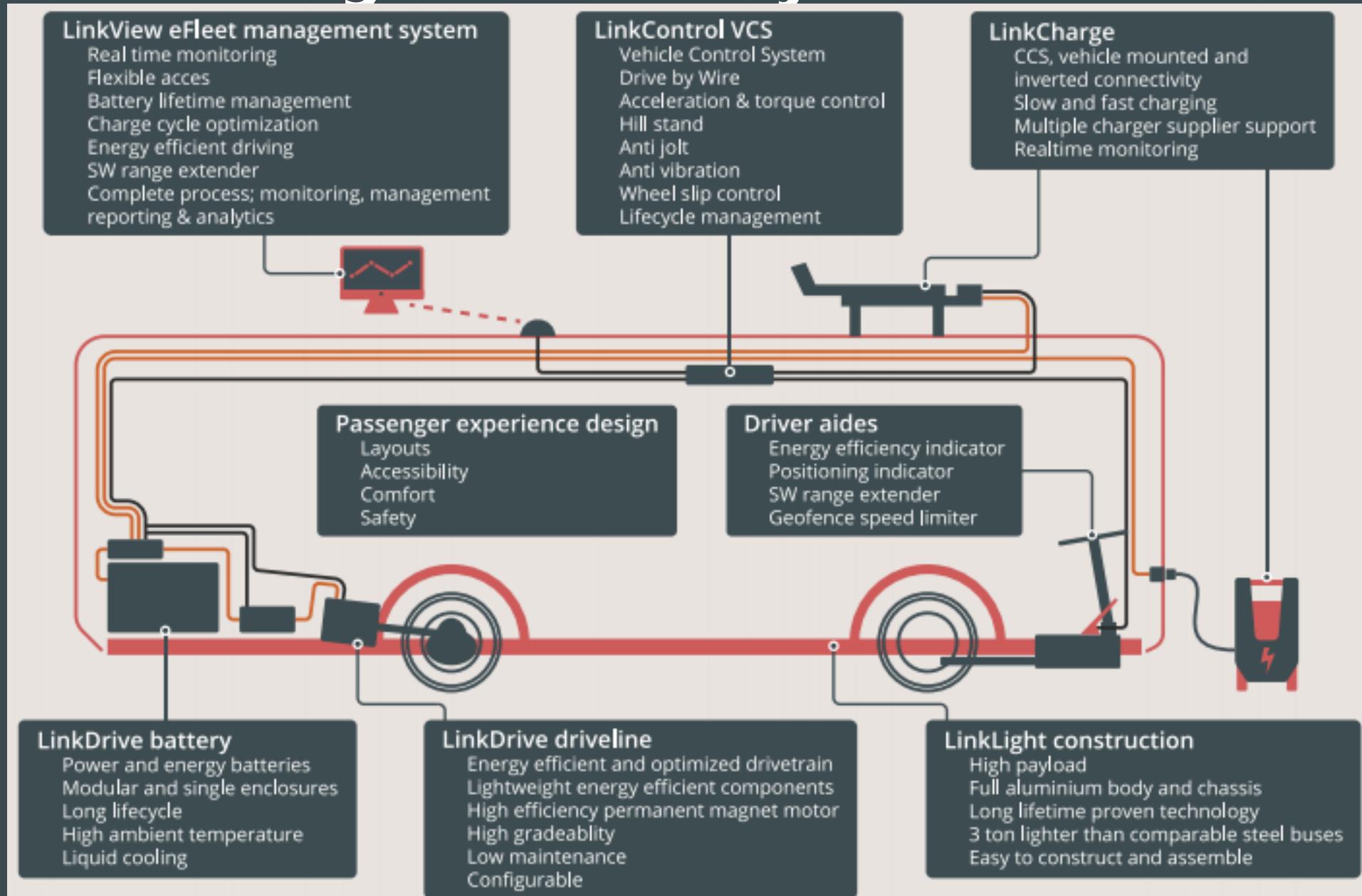


IoT & digitalization

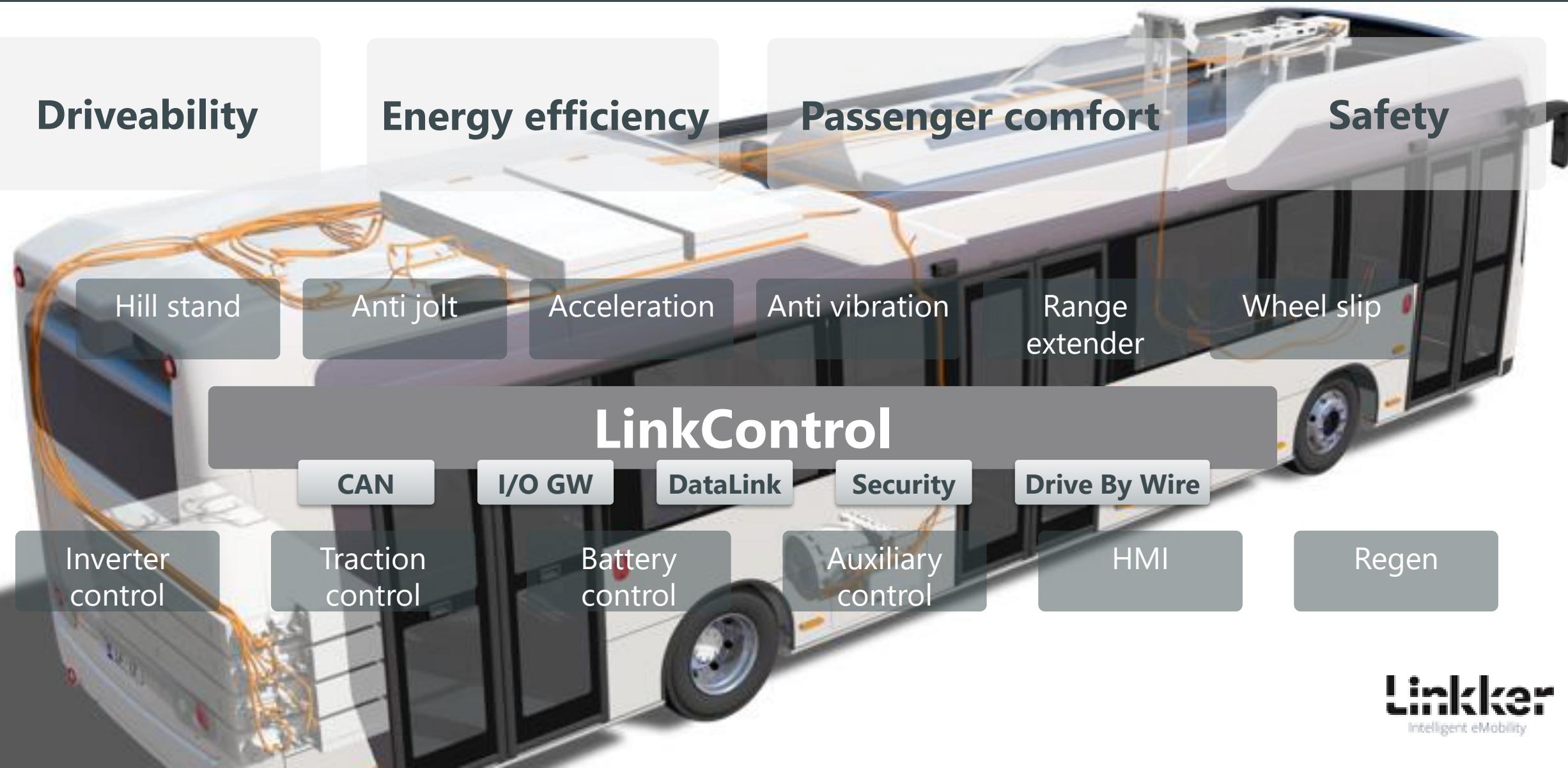


Automation

Linkker Intelligent eMobility Platform

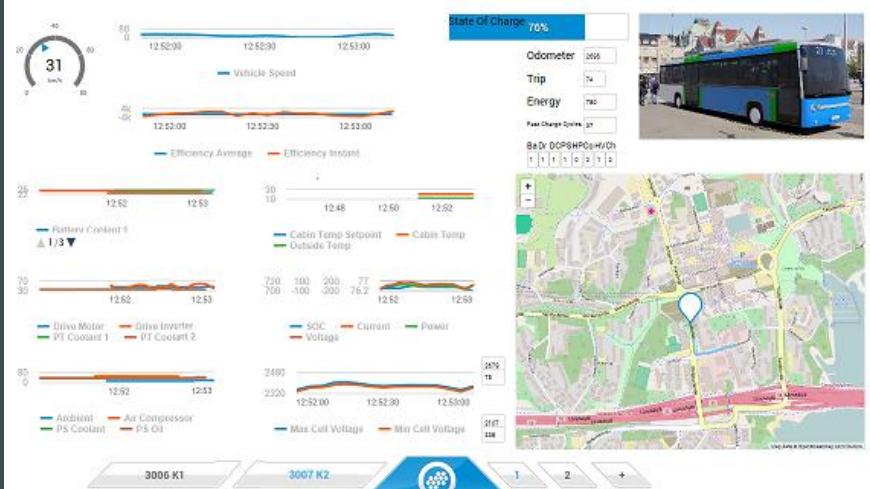


LinkControl – Vehicle Control System



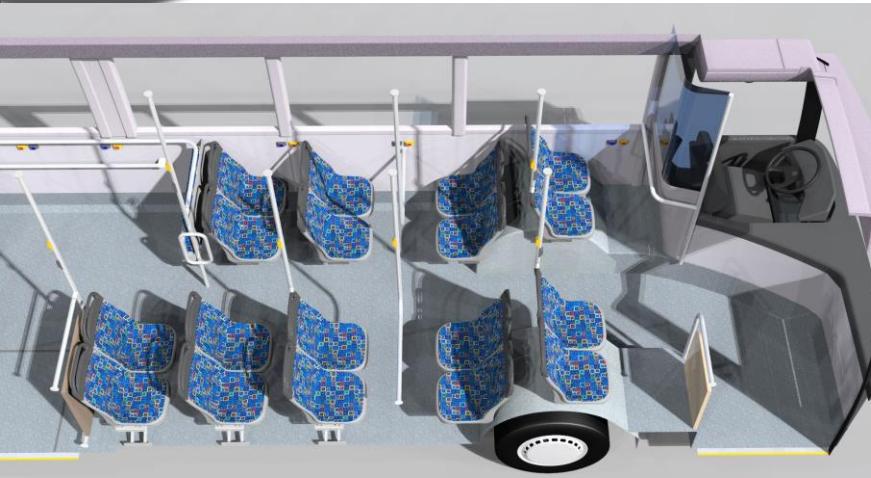
Linkker Products

Linkker electric buses



LinkView operational SW

LinkDrive drive line & ultra fast charging



LinkLight chassis and body

Linkker Technology

DONE

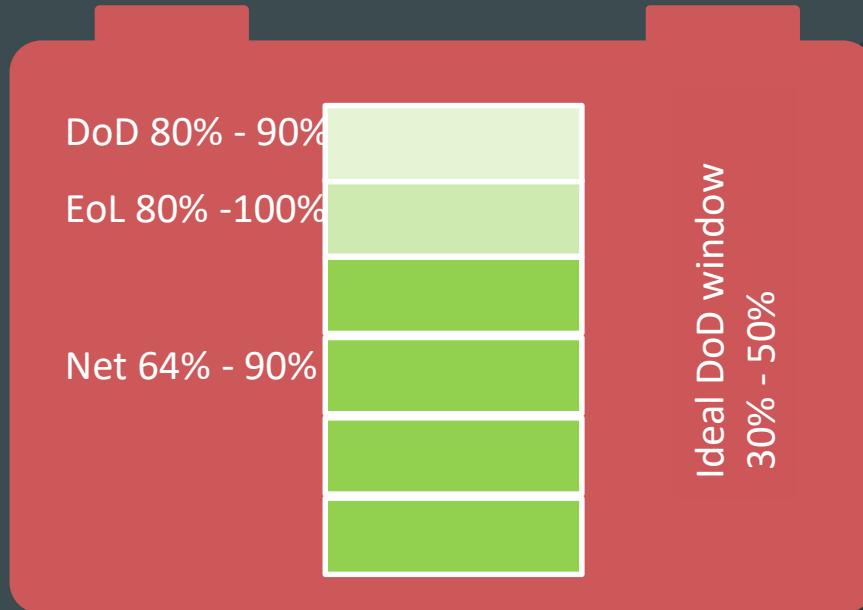
- 2015 LinkDrive
- 2016 Linkker 12 LE+
- 2016 Inverted pantograph
- 2017 Drive by Wire option
- 2018 LinkControl charging protocol and LinkView diagnostics
- 2018 NMC battery 177kWh Durapower
- 2019 Linkker 12 LF

PLAN

- 2019 Launch of Linkker 12 LF
- 2019 MAN A22 retrofit kit
- 2019 Daimler bus retrofit kit
- 2019 LFP battery 177kWh, LFP battery 398kWh
- 2019 Battery as a Service
- 2019 Automation applications
- 2019 Satellite production start in Moscow and Malaysia
- 2020 Integrated management console fleet & infrastructure
- 2022 Limited full automation



Configuring eBUS systems



AUTONOMY

Energy storage capacity, kWh
Charging rate, kWh/min
Consumption, kWh/km



CHARGING

Charging power, kW
Charging duration, min.
Charging frequency, per day



Configuring eBUS systems

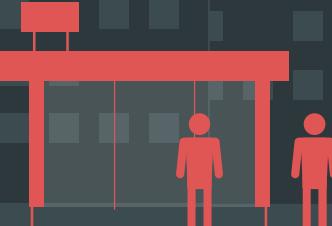
Capacity

- Daily mileage
- Network coverage
- Transportation capacity
- Size of fleet
- Hours of continuous operation
- Mileage in high consumption scenarios



Time table performance

- Service level
- Peak and off peak operation
- Traffic conditions
- HVAC usage
- Payload



Total Cost of Ownership

- Battery cost
- Charging cost
- Life cycle cost
- Technology and standardization
- Driver cost



Intelligent eMobility Performance

Increasing revenue



Improved efficiency
30% lower consumption

Modular energy storage
& life time management



24 x 7 operation
+350km mileage

Decreasing life cycle cost



high power charging
2-4min typ.



Predictive & lower maintenance



High time table
performance



Passenger Experience

We will partner you all the way



Process from idea to operation for a city

Increasing revenue



1 Vision & strategic decision

2 Validation period



3 System optimization



4 Start of the fleet roll-out

Month



Decreasing life cycle cost



PERFORMANCE

- Line profiling
- Time table analysis
- Charging cycle simulation
- Daily mileage and 24 x 7 analysis

AVAILABILITY

- Infrastructure & storage configuration
- Fleet management solutions
- Maintenance strategy

TCO

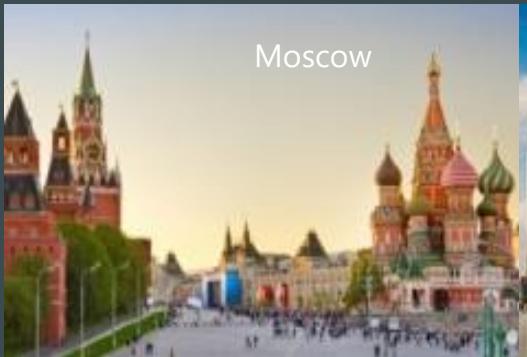
- Cost driver analysis
- Business driver analysis
- Risk management
- Optimization

Linkker Passenger Experience Design

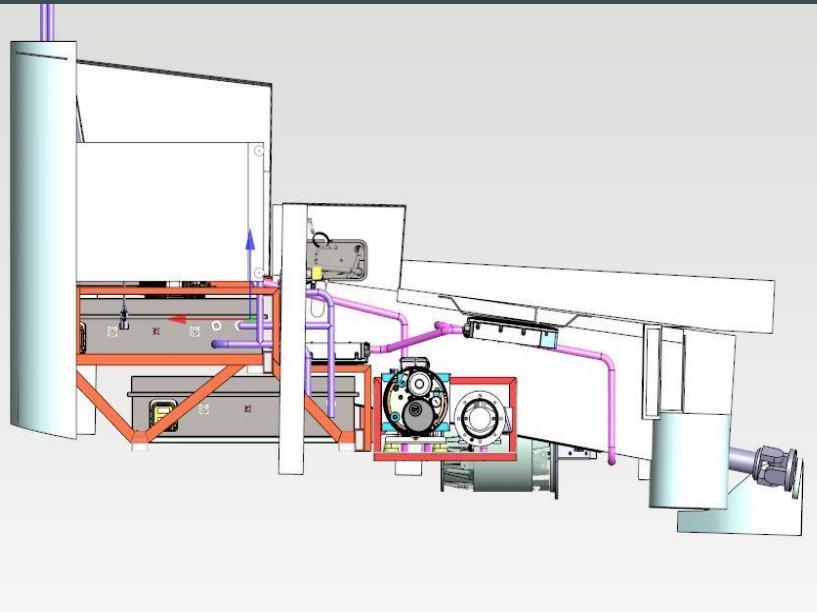


Linkker – References

Linkker is already proven and market tested



Linkker LinkDrive Kit – MAN A22 conversion



Permanent Magnet Motor

Max effect 208kW
Max torque 7.350 Nm at rear axle

LinkControl VCU

Acceleration control, anti vibration, anti jolting, hill stand, wheel slip control

Battery & charging

177kWh LFP 3C charge rate

350-450kW charging power

20 min for full charge

Pantograph inverted

0.8 kWh/km ... 1 kWh/km

Range between charging 120km

Propulsion related consumption

Case examples APAC and Eurasia

Main steps of co-operation

- Teaming up with strong local partners (distribution and production)
- Introduction of Linkker concept with high operational performance and opportunity charging
- Addressing key customers together
- Realize first pilot as blue print for other cities to follow
- Localize design and obtain local approvals
- Start of local production supported
- Distribution and maintenance
- Digitalization
- Automation

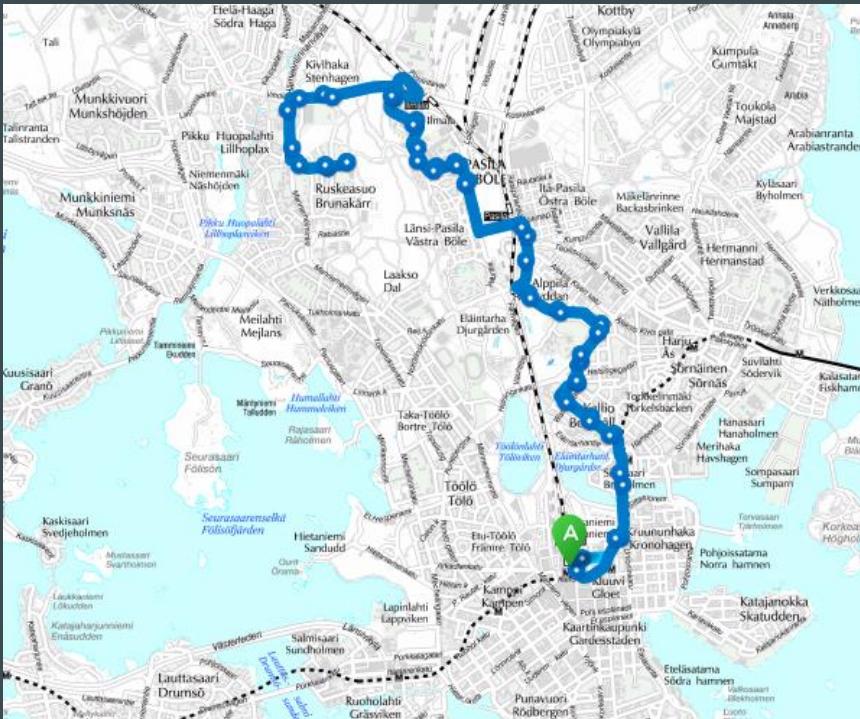


12 LF RHD AV, Singapore



12 LF LHD Moscow

Case Helsinki Line 23



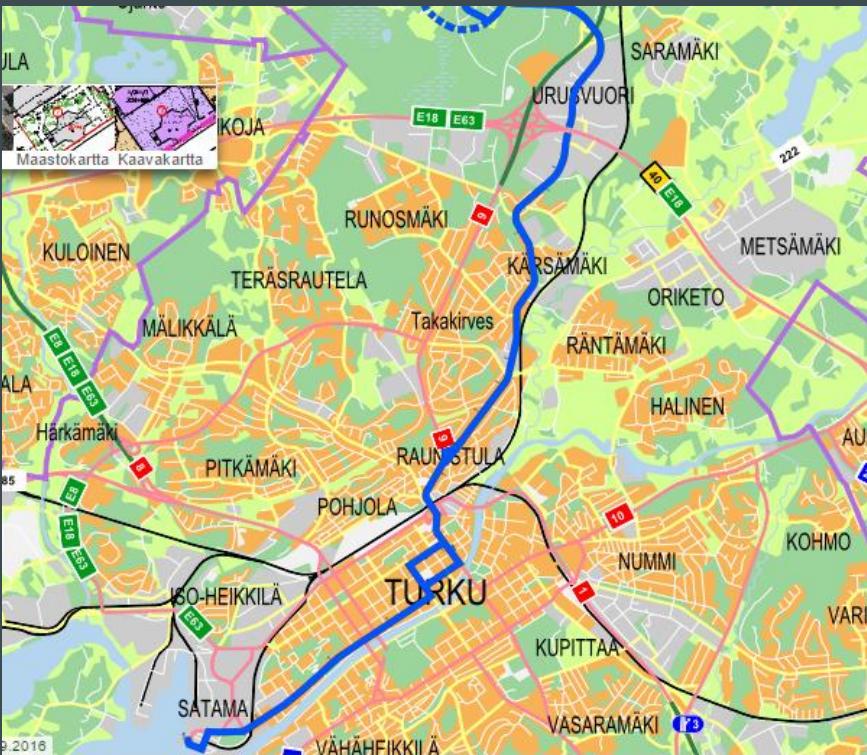
First electrified line in central Helsinki

- Ruskeasuo – Pasila – Central station
- 8,9 km line A->B
- Average speed 17,7kmh
- 30 stops
- Daily mileage 260km
- 15 fast charging events / day

Electric Bus System

- 1x 350kW end-stop charging event in Ruskeasuo
- 2nd charger in August 2018 at Central Station
- Consumption 0.897kWh/km
- Avrg. charged energy 16kWh
- Charging time 3,5 min

Case Turku 1



- Harbour – Airport
- 24,8 km A→B →A
- Average speed 20 kmh
- 35 stops
- Daily mileage 350km

Electric Bus System

- 2 x 350kW end-stop charging event
- Consumption Avrg .0.906kWh/km
- Charged energy Avrg. 12.4kW
- Charging time 4.73min

Case Luleå Line 6



- Porsö - Östra Kronan/Lulsundsb.
- 10,4 km A→B →A
- Average speed 20 kmh est.
- 20 stops
- Daily mileage, up-to 250km

Electric Bus System

- 2 x 400kW end-stop charging event
- Inverted connectivity
- Consumption avrg. 1.2kWh/km
- Charged energy 20.6kWh
- Charging time 4-5min.

Linkker

Intelligent eMobility



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