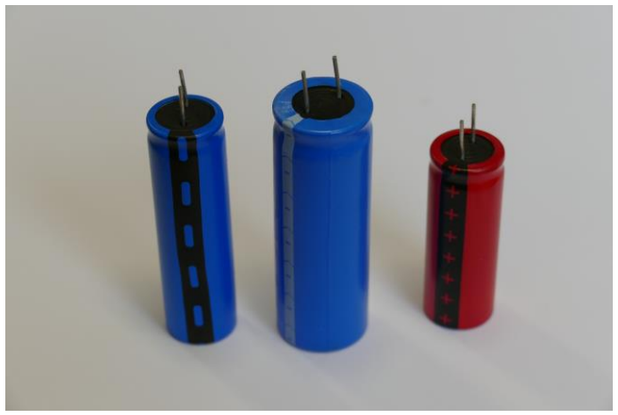
www.KURT.mobi



KURT as catalyst for urban electric mobility

From Vehicles to Mobility as a Service

SEAL OF EXCELLENCE

Altreonic NV - previously Eonic Systems NV

30 years safety-critical embedded software

- Experience in trustworthy systems engineering
- ESA: Virtuoso RTOS in Rosetta mission
- Sold to Wind River Systems in 2001

- First time to China: 1998
- Office in Shanghai in 2000

Today:

- 5Gen unique fault tolerant VirtuosoNext RTOS used in KURT
- GoedelWorks: Systems Engineering portal for traceability and certification

Applying technology: Kurt.mobi

KURT for urban mobility: one scalable concept

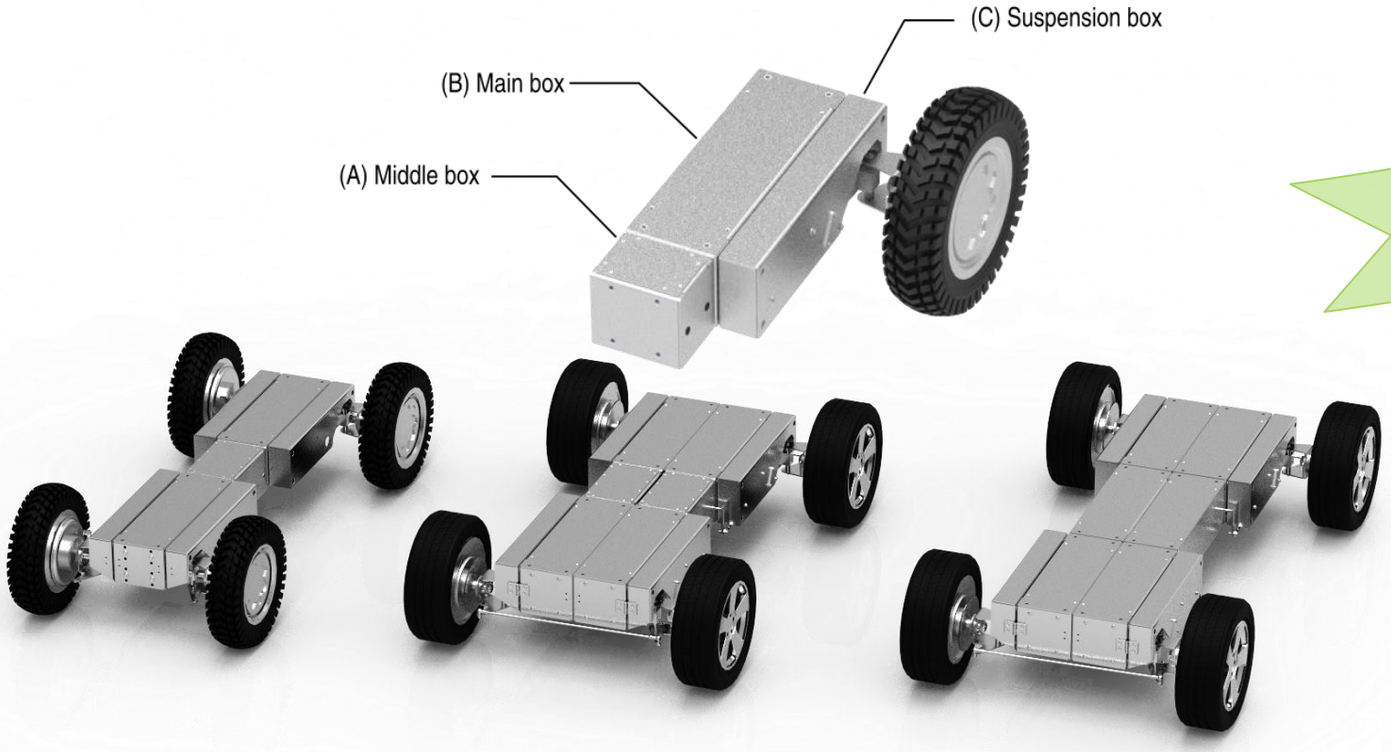
City-KURT:
Small yet powerful

Last mile delivery

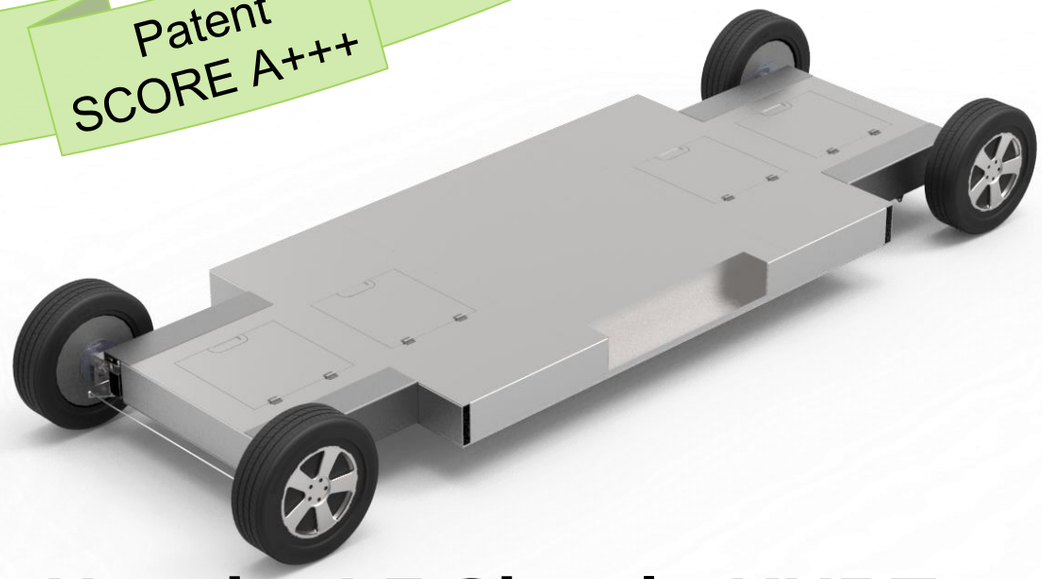
Shuttle-KURT:
the only L7-shuttle below 450 kg

Cost-efficient yet robust
Optimal e-consumption
Very fast e-charging
Multi-purpose & modular
Safety

Modular & scalable propulsion platform

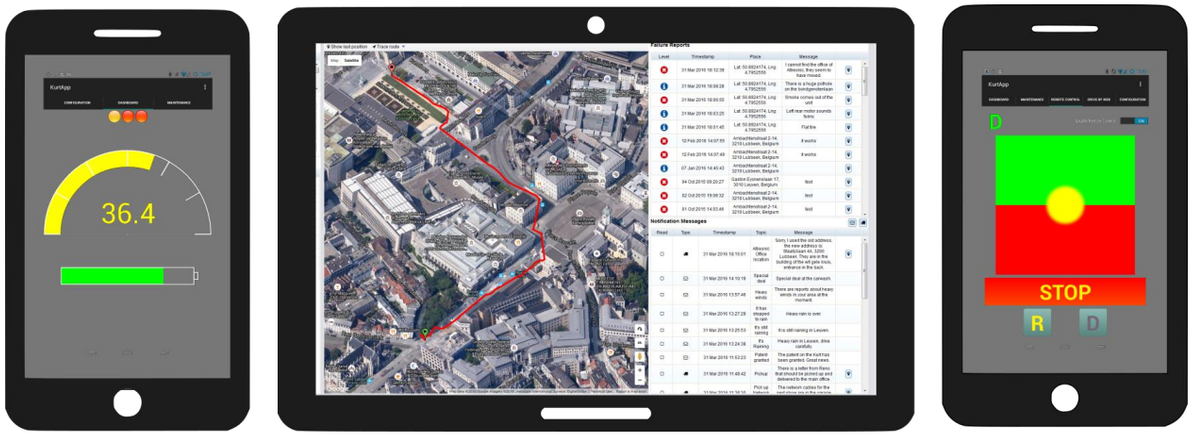


Patent
SCORE A+++



Heavier L7 Shuttle-KURTs
Empty weight: 450 to 650 kg
Cargo: up to 2 ton
(steel:10 ton)

Light City-KURTs:
Empty weight 100 kg
Cargo: > 200 kg



Software driven
Integration with smartphone
Remote fleet management
Remotely driven / monitored

Differentiating factors

Lower assembly and production cost

- IKEA concept
- Use of reusable aluminium
- Software driven

Lower energy consumption

- Lower empty weight
- Higher load/empty weight capability

All-weather:

- **New type of batteries operate from -20/-40°C to +50°C external**
- Driver is protected, heating in seat

Fast charging

- **New types of battery allow higher peak current (10C sustained, 20C peak)**
- **Charging in minutes, not hours**

Safety

- Fault tolerant VirtuosoNext RTOS, redundant architecture
- **Obstacle detection/avoidance, semi-automated driving, remote monitoring**

Shuttle-KURT SK1 for moving people

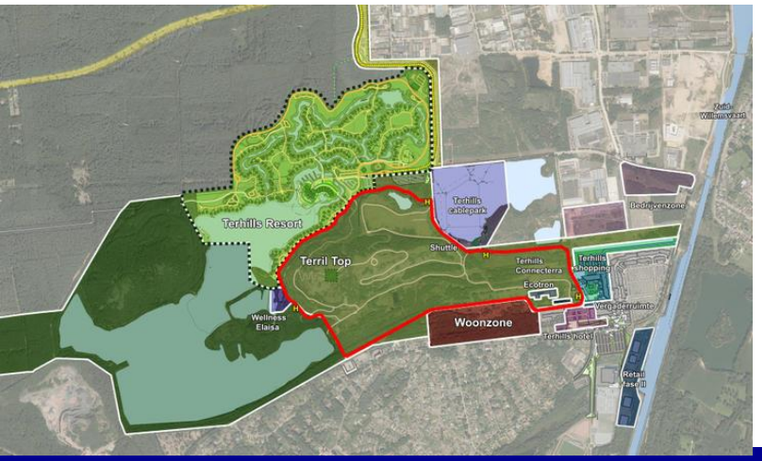
SK1 platform for logistics

Case study leisure resort: complete solution!

Closed circuit: shuttles only

- SK1 Shuttle-KURTs (15 - 20 vehicles)
- **Semi-autonomous driving: system using cameras**
- **Charging station: fast charging in minutes from 380 VAC/120 A**
- **Mobile charging station: using buffer batteries**
- **Opportunity charging from 220 VAC/16 A**
- Dispatching Center: fleet management, monitoring, remote steering

- Other opportunities:
  - Utility vehicles: CK2 City-KURT
  - Logistics: adapted SK1 Shuttle-KURTs



Why China?

You can’t live without it

What you can’t source here, you can in China

- Many parts are only available or affordable from China:
  - In-wheel hub motors
  - Cost-efficient batteries + chargers
  - Motor controllers
  - But:
    - For custom made parts:
      - Only after design is final
      - Only when your specifications are very detailed
      - Only when volume offsets transport and import costs

Why?

- China was/is focused on volume manufacturing
- China is focusing on changing fast (and leapfrog)
- Focus has shifted to sustainable innovation

AI driven one-minute medical clinic booths launch in China

by **Startacus Admin**

The Shanghai based healthcare innovation - unmanned, AI-driven 'one-minute clinics' providing medical services, including diagnosis and medicine prescriptions.

Myths about China

Contrary to popular belief (media!):

- China is evolved very rapidly
- It's becoming very western
  - (and consumer focused)
  - WeChat, Alipay, Digitalisation: ahead of the West
  - E-mobility: ahead of the West
- Many educated Chinese speak / write / read English
  - And the Translate App are excellent
- Chinese cities are becoming clean very fast
- But also: China working time = 9-9-6
- 12 x 5 year strategic planning

Hidden at Hannover Messe

based in Shenzhen,
Family owned
Shenzhen is capital of e-driving:
taxis, busses, scooters, (BYD)

2 meetings: MOU for JV in December 2018

Game changing carbon based ultracaps for battery packs and energy charging/storage

Game changing battery packs

Carbon based ultra capacitors have energy density of Li-ion batteries but operate from -40°C and charge/discharge at upto 20 x nominal current with no thermal risks

Models

80 Wh/kg

100 Wh/kg

200 Wh/kg

Car Starting Battery

variants

60Ah/70Ah/80Ah/110Ah

Heavy Duty Starting Battery

Used for heavy vehicles

Application-Specific Battery

Drones, EV, Ship, Base Station, Energy Storage Station, Frequency grid adjustment, Laser, etc.

Properties and advantages

Power and energy density of carbon-based supercapacitor battery has reached the level of lithium battery.

Excellent performance:

Fast charging and discharging: 10 - 20 X nominal current

Economical: smaller battery packs needed

Excellent temperature behaviour

Working temperature range: -40℃ ~ +70℃

Safe to use

Exceptional life time

No rare earth materials: C & Al

Fast charging, yet smaller and safer batteries is a game changer

Applications

Bus :

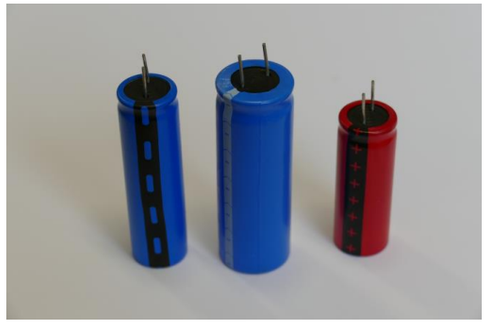
- Length: 8.2 m
- Battery Capacity: 50 kWh
- Voltage: 600 V
- Range/Full Battery: 70km
- Charging Time: 20 minutes

Truck:

- Weight truck: 20 t
- Battery Capacity: 18 kWh
- Voltage: 600 V
- Range: 18 Km

Minivan:

- Vehicle capacity: 6 seats
- Battery Capacity: 4.5 kWh
- Voltage: 48V
- Range/Full Battery: 50Km
- Charging Time: 20 minutes



Electric Scooter:

- Battery Capacity: 1.2 KWh
- Voltage: 60 V
- Range/Full Battery: 75 Km
- Charging Time: 20 minutes

Comprehensive comparison of batteries

	Lithium iron phosphate battery	NMC lithium battery	Lithium titanate battery	Power-type C-supercap battery	Energy-type C-supercap battery
Energy density（Wh/kg）	90 - 150	180 - 250	70 - 95	**80 - 100**	**180 - 220**
Power density (kW/kg）	0.1 - 0.2	0.1 - 0.5	0.5 - 1	**1 - 1.5**	**0.3 - 0.5**
Typical charging/discharging rates	1.0 C	0.7 - 1.0 C	1.0 - 5.0 C	**10.0 - 20.0 C**	**1- 1.25 C**
Working temperature (℃)	-10 ~ 55	-20 ~ 45	-40 ~ 60	**-20/-40 ~ +70**	**-20/-40 ~ +70**
Cycle life（times）	2000	2000	5000	**> 50000**	**> 20000**
Safety	acceptable	not good	good	**excellent**	**excellent**
Complexity	Medium: BMS	High: BMS + thermal mgt	Medium: BMS	**Low: no BMS, passive cooling**	**Low: no BMS, passive cooling**

C-based supercaps:
a catalyser for clean and sustainable energy

Applications of C-based supercaps: from Watts to MWh

- Powerbanks (charging in 10 min)
- Starter batteries (for ICE vehicles, 5% less fuel needed)
- Serial hybrid vehicle drives
- Fast charging vehicle batteries
- Energy buffering storage
- Frequency grid adjustment
- Home energy system
- ….

Two examples:

1. Vehicle battery (agriculture)

- 50 % less than requested volume
- 200 % of requested capacity
- Lifetime 10 x more

2. MWh battery

- 50% less volume (5 m3)
- Lifetime 10 x more

Why did Tesla buy a supercap company? C-based supercaps are 10 to 20x better

Kurt.mobi, a division of Altreonic

Flexibele last-mile logistiek en vervoer voor stedelijke omgevingen
Compacte City-KURTs en grotere Shuttle-KURTs voor een continu transport en vervoer tussen parkings en depots buiten de stad, en het centrum.

Innovatieve Mobiliteit en Transport als een Dienst
KURT voertuigen kunnen verhuurd of gedeeld ingezet worden voor vervoer van personen en goederen. Met mobiele wacht en laadstations wordt mobiliteit terug een ontmoeting. Optioneel Fleet management op afstand.

Efficiënt vervoer voor campussen en parken
Leefbare en energie zuinige mobiliteit. Klantgericht en uitermate geschikt voor geluidsarm en veilig transport van mensen en goederen.

Het KURT platform is modulair en schaalbaar
Dankzij een laag eigengewicht is het stevige metalen platform niet alleen energie en kost efficiënter, het is ook volledig milieuvriendelijk en aanpasbaar voor alle toepassingen.
Made in Vlaanderen!

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Software driven electric mobility

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