BATTERY MANAGEMENT SYSTEMS

Davide Andrea

Elithion

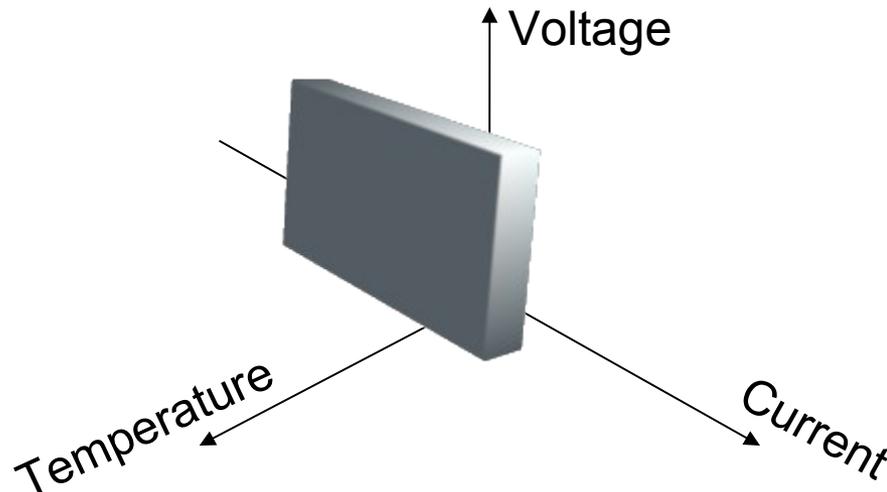# Li-ion cells Safe Operating Area

- Li-ion cells are great…
  if operated within their SOA

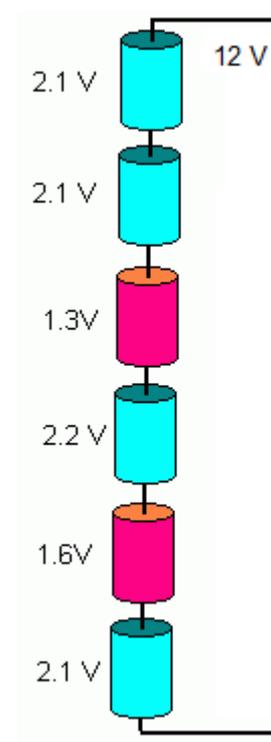- Else

BMS MAIN FUNCTION: PROTECTION

- A BMS keeps **<u>EACH</u>** cell within its SOA

BATTERY PROTECTION

- Protecting a single cell is hard enough

- Protecting a battery
(a series string) is harder:
cell voltages do not divide equally,
temperatures vary

BMS 2nd FUNCTION: BALANCING

- All cells equally charged = maximum available energy

- Balancing removes charge from fullest cells, to leave room for more charging, so the other cells can catch-up
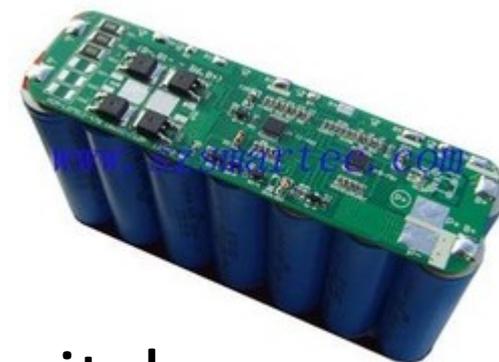
ANALOG BMS ("protector", "PCM")

- Voltage protection

  May have:

- Balancing, current protection, switch

  BUT

- Knows not what, where and by how much

DIGITAL BMS: MUCH MORE

- Evaluation of State of Charge ("Fuel Gauge")

- Evaluation of State Of Health

- Knows what, where and by how much

- Reports

- <u>Requests</u> shut down (doesn't include switch)

SYSTEM <u>MUST</u> OBEY BMS
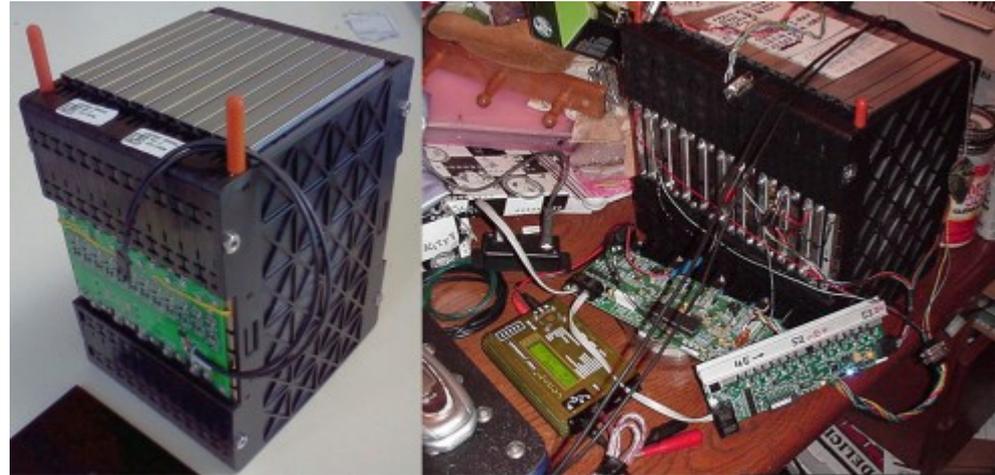
- BMS can't do a darn thing if nobody's listening
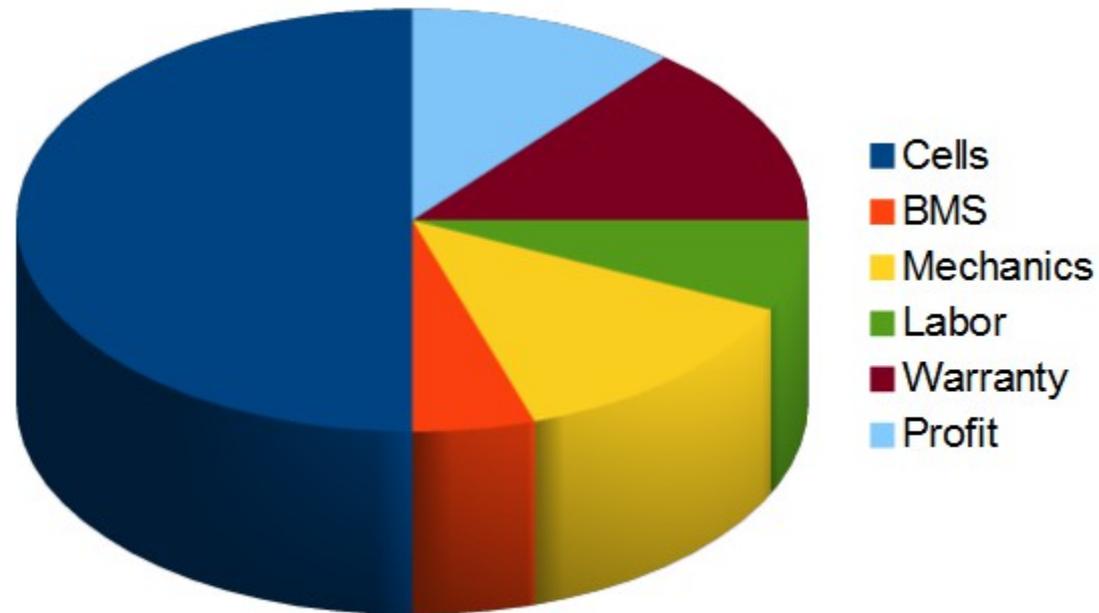
STOP!

BMS

SYSTEM

TYPES OF BMS

- Analog vs Digital

- Off-the-shelf vs custom

- Distributed vs non-distributed

BMS COST

- Custom:
2 years, $ 250 K

- Off the shelf:
immediate,
no NREs,
50 % premium

TRACTION PACK COST

Legend:
- Cells
- BMS
- Mechanics
- Labor
- Warranty
- Profit

THANK YOU

Resources:

- Li Ion BMS .com: comparisong tools directories, white papers

- "Battery Management Systems

for Large Lithium-Ion Battery Packs "