

MOD battery requirements for Li/S

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Contents

- General battery requirements
- Potential applications
- Perceived advantages of Li/S
- Challenges for Li/S

Battery requirements

- Light
- Small
- Safe
- Cheap
- Rechargeable
- Wide temperature range
- Robust

Applications

- Soldier batteries
- Unmanned vehicles
 - UUVs
 - UAVs
- Ground based equipment e.g. cameras, sensors etc
- Other

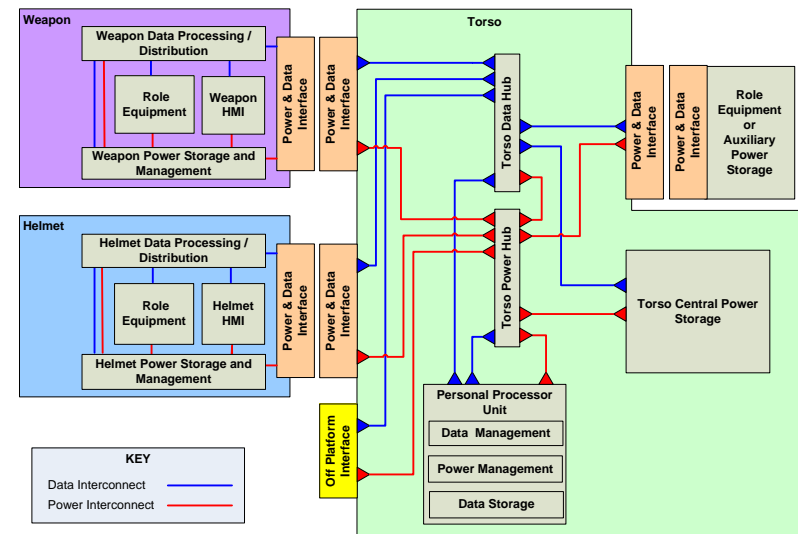
Soldier batteries

- Need for discrete batteries for some equipment
- Future seen to be a central battery to power the soldier system
- Potentially flexible to some extent



Generic Soldier Architecture (GSA)

- Def Stan 23-12
 - identifies the critical interfaces, and specifies the standards to be used when designing equipment for the dismounted soldier
 - enable ‘plug and play’ of legacy and future systems for soldiers
 - facilitate technology insertion
 - V2 with Defence Standards Organisation for publishing
 - will have a power impact
 - based upon a central power source



Soldier power requirement

- Very variable
 - depends on mission and role
 - dominated by comms
- Future
 - Likely to grow
 - Rifleman 1-7 W av
 - Commander 10-20 W av
 - Much uncertainly
- Battery size
 - 50-100 Wh

Soldier considerations

- Will a worn battery need to be safer than a carried battery
- Are Li-ion 18650 cells acceptable?
- Does a flexible battery provide military advantage or is it a 'nice to have'?
- Weight is very important
- Is -40°C to $+70^{\circ}\text{C}$ appropriate?
 - equipment specification for soldiers being reviewed to be less harsh to save weight

UAVs

- UAVs likely to become more important in future
- Small to medium systems likely to rely on batteries
- Larger systems will use combustion engines/turbines
- May have high power requirements for take off
- Typically high C rates in general as flight times are shorter 1-2 C
- Weight is more important than volume

UUVs

- Will also find more use in future
- Safety could be very important if stored in a submarine
- Weight and volume important
- Neutral buoyancy often sought
 - Li/S good for this
 - neutral buoyancy not always needed since other parts of system can be lighter/heavier than seawater

Ground based systems

- E.g. base perimeter sensors, cameras etc
 - could need a very wide temperature range depending on base location
 - not as weight and volume constrained but still need to be transported
- Base energy stores to make better use of generators and introduce renewables
 - through life cost is greatest barrier to energy storage

Other - submarines

- Would Li/S ever be possible to replace a submarine main battery?
- Currently lead acid but Li-ion has been considered for future
- Safety and through life cost is critical
- MW and MWh
- Emergency battery on nuclear submarines
- Could be the main battery on conventional and AIP (air independent propulsion) submarines

Other - vehicles

- Could Li/S find use on military land vehicles
- SLI battery
 - Li-ion alternatives to lead acid 6T now available
- Auxiliary battery
 - to power communications, surveillance etc equipment
- Hybrid vehicles
 - less likely until commercially proven

Advantages of Li/S

- Higher specific energy
 - Li-ion also improving but Li/S has great potential
- Safety?
 - Is Li/S safer than Li-ion in all failure modes
 - What happens in a fire when melting point of Li (180°C) reached?

Challenges for Li/S

- Energy density (volumetric) will struggle to beat Li-ion
 - want lighter batteries but don't want bigger batteries although in many cases would accept
- Cyclelife
 - Although in many cases would trade cyclelife for weight ideally still want hundreds of cycles
- Cost
 - Should intrinsically be a cheaper technology than Li-ion but needs to compete with very high volume manufacture e.g. gigafactories
- Different voltage profile
 - Single cell applications less likely
- Transportation
 - Is Li/S classed as a 'lithium metal primary' or 'Li-ion secondary'

Conclusions

- Dstl interested in Li/S but technology agnostic
- Li/S has to prove its merit over competitors Li-ion, fuel cells, others etc
- If continues to develop at current pace likely to find niche military applications (UAVs, soldiers)
- Will it displace Li-ion in bulk markets?