[dstl] The Science Inside

Trends and Opportunities for Soldier Power

Dr Darren Browning

Dstl

Ministry of Defence

DSTL/PUB156501

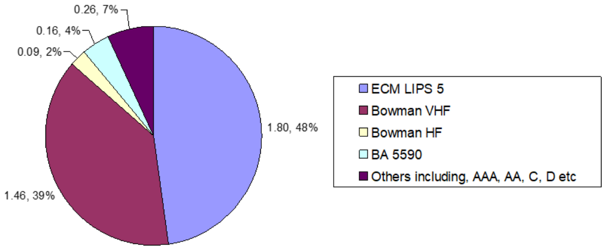
UK OFFICIAL

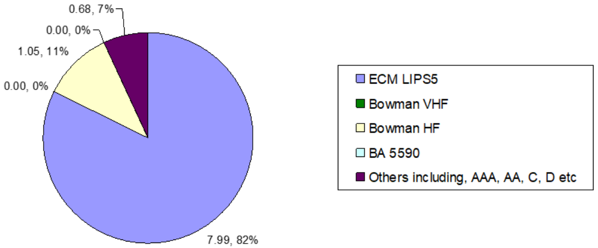
Contents

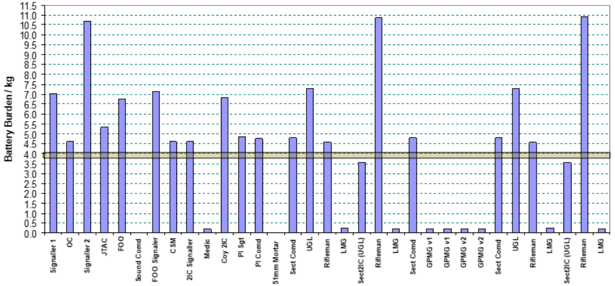
The Science Inside

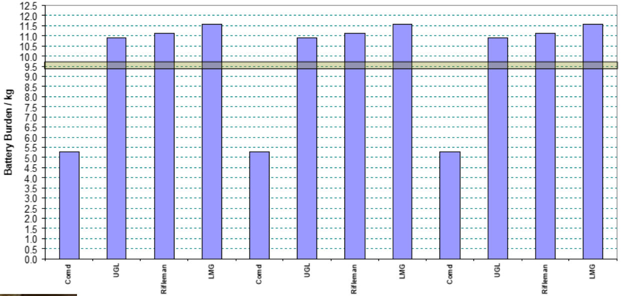
- Power Growth
- Power Sustainment
- Standardisation

Context for a soldier system









UK OFFICIAL

Future power

[dstl] The Science Inside

- Increases due to:-
  - Dismounted Situational Awareness (DSA)
    - (phone, hub and data radios)
    - eDSA 7.4 – 9.4 W av (cdr)
      - Depending on radio choice
  - UAS/UXV control
  - Anti UAS systems
  - Electronic Warfare
  - Increased SA (thermal/ I2)
  - Tactical AI
  - Heads up displays

- Requires:-
  - Bigger or more batteries
  - Better batteries
    - Newer chemistries
  - Battery alternatives
    - E.g. fuel cells, fuel based thermoelectric, micro engines
  - More tactical battery recharge
    - Scavenge energy where possible

Sustain the Fight

[dstl] The Science Inside

- Important not just to focus on electrical energy on the soldier but also how that is sustained
  - With increasing use of rechargeable batteries that means recharging
    - Appropriate chargers with the correct connectors
      - Flexible chargers
    - Electrical energy for those chargers
    - Fuel for any generators powering the chargers
    - Fuel for any novel power sources e.g. fuel cells
    - Potential for use of renewables e.g. solar and wind
      - But likely need intermediate storage e.g. bigger batteries since can’t rely on renewables

Sustain and speed and time of relevance

[dstl] The Science Inside

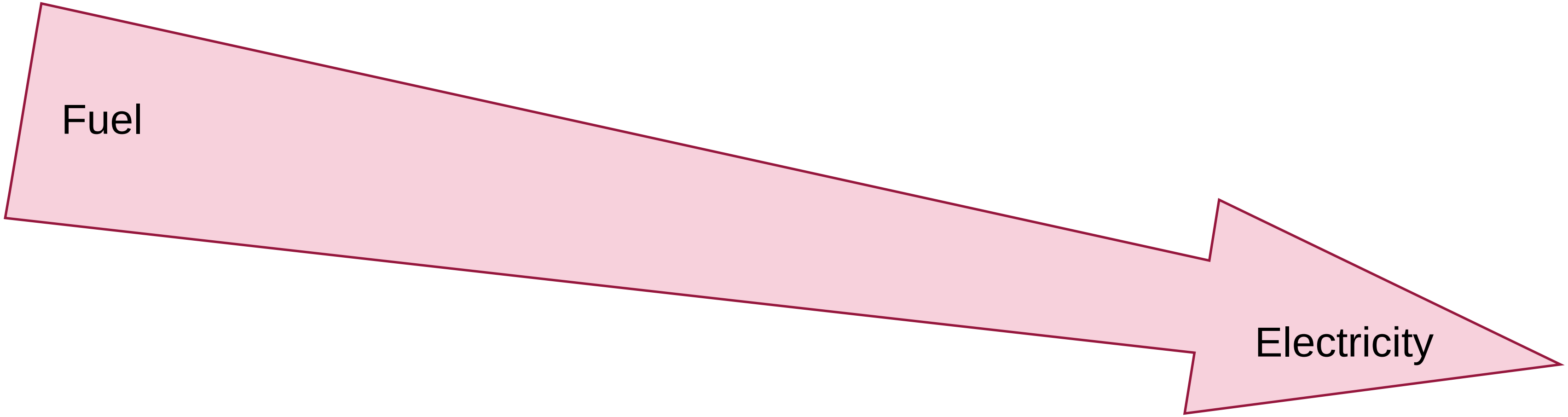
- Normal tempo revolves around perform a mission, come back and recharge batteries
  - Is this fast enough?
  - Assumes batteries last the mission length
- When batteries don’t last mission length need to carry more or “top up” during mission
- Emerging issue is small to medium Uncrewed Aerial Systems (UAS)
  - Typical flight times 20 mins to 1 h
  - After that they are dead weight
  - Need a means to recharge during the mission at section level
  - Sensor Decider Effector **Sustainer** (SDES) loop

Experimental sustain options

- Scavenge from carried batteries
  - E.g. BB-2590 and CWB “toppers”
- Scavenge from vehicle sources
  - MRZR demonstrated via SPM
  - Exploring IFVs/AFVs etc.
- Renewables much slower
  - Suited to longer missions or base supplementation

Battlefield energy flow (energy toolkit/golf bag)

[dstl] The Science Inside



Standardisation

[dstl] The Science Inside

- Electrical energy and batteries are proliferating
- Charging is already an issue
- UAS and UXVs are complicating matters further
- Need to standardise batteries and interfaces where possible
- Can't have a single battery as voltage and size won't be correct
- But can standardise a number of common interfaces and formats
  - Simplifies charging
  - Simplifies logistics
  - Simplifies procurement
  - Allows scavenging

NATO STANAG 4695 & 4851

[dstl] The Science Inside

- Standard soldier power connector & data connector
- Connector has two different pin assignments depending if it is a battery connector or a device connector
  - Battery connector/port needs to communicate with SMBus
  - Device/data ports are USB 2.0
    - Plus additional 10-20 V
- Conceptually this is achieved by connection through a hub device
- The hub enables the SMBus and USB system to co-exist and provide a functional platform for the digitally enabled soldier
- Power capped at 50W, max voltage of 20V
- Based upon US Nett Warrior
- Adopted by UK Generic Soldier Architecture

©Dstl

Pin	NATO Dismounted power connector	NATO dismounted accessory connector (data connector)
1	Power from energy source Positive (10-20 V)	Power (10-20 VDC)
2	Power Ground– extended pin	Ground – extended pin
3	Power to energy source Positive (for rechargeable power sources)	Power (5 VDC @ 2A Max
4	SMBus Data	USB + (data)
5	SMBus Clock	USB – (data)
6	Safety signal [as per reference SBC section 6.1.1	USB Detect

Future ideas – USB Power Delivery

[dstl] The Science Inside

- USB-PD widely used by commercial systems
  - Phones, many COTS drones
- USB power delivery is enabled by a two wire command and control protocol
  - Defined as CC line connection and a Vconn connection
- VConn provides uninterrupted 5V power for the chipsets within cables/devices
- Data and power roles are independently definable and swappable
  - Not easily achievable in current GSA systems
- Enables a level of control not easily implementable in previous soldier systems
- Defined available voltages from 5V to 48V and powers up to 240W
  - Solves the traditional battery issue that voltage is controlled by number of cells in series
  - Achieved by buckboost converters
    - potential source of inefficiency
- Vendor defined messages possible – sit outside standard USB core control
  - Potentially suitable for a military USB environment

Conclusions

[dstl] The Science Inside

- Soldier power demands are expected to increase
  - More capable radios, better SA, UAS/anti UAS, tactical AI, EW etc.
- Sustaining soldiers will become more important and more challenging
  - More battery types complicates charging
- Standardisation can simplify logistics and charging
  - Fewer battery types, fewer chargers/charging interfaces
- NATO STANAGS 4695 and 4851 can help
  - But not the complete solution
  - Need smaller interface for UAS – perhaps USB-C
  - Can USB-PD and USB-C principles be used for future on soldier connectors?

[dstl] The Science Inside

Discover more