



**open TRV**

**Secure funky sensors  
cheap and at scale**  
Damon Hart-Davis

**w** [opentrv.org.uk](http://opentrv.org.uk)

**t** [@opentrv](https://twitter.com/opentrv)

**e** [opentrv@opentrv.org.uk](mailto:opentrv@opentrv.org.uk)

# Questions 1

How many of you here are:

- S/w devs
- H/w devs
- Have budget and likely to commission IoT?

What is the real-world IoT value chain?

Is more money at the s/w or h/w end?



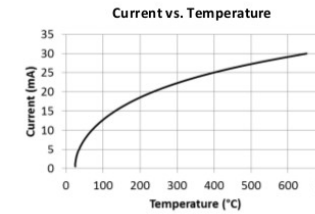
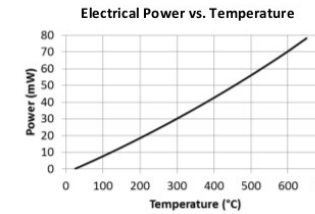
Electrical Characteristics

Parameters	Conditions	Typical Value	Units
Operating Temperature		600	°C
Thermal Rise Time (t <sub>90</sub> )		15 ± 5	ms
Thermal Fall Time (t <sub>10</sub> )		30 ± 5	ms
Power Consumption (P <sub>VI</sub> )	DC @ 600 °C	72 ± 7	mW
Heater Voltage (V <sub>H</sub> )		2.4 ± 0.3	V
Heater Current (I <sub>H</sub> )		30 ± 4	mA
Ambient Resistance (R <sub>a</sub> )		40 ± 10	Ω
Heater Resistance (R <sub>H</sub> ) <sup>1</sup>		80 ± 20	Ω
Heated Area		0.05	mm <sup>2</sup>
Emissivity	2 - 14 μm wavelength	0.7	
Frequency at 50% Modulation		38	Hz
Lifetime	600 °C @ 50% duty cycle	>5	years

Note:

1.  $R = (R_0 - RT)[1 + \alpha(T - T_0) + \beta(T - T_0)^2] + RT$ ;  $T_0 = 25^\circ\text{C}$ ;  
 $RT$  (Track Resistance) =  $12\Omega \pm 0.5\Omega @ 25^\circ\text{C}$ ;  $\alpha = 2.05 \times 10^{-3} \text{ K}^{-1}$ ;  $\beta = 0.3 \times 10^{-6} \text{ K}^{-2}$

Infrared Source Performance



The contents of this document are subject to change without notice. Before ordering or considering the use of CCS devices where failure where extremely high levels of reliability are demanded, CCS will not inherently a certain rate of failure, it is therefore necessary to protect

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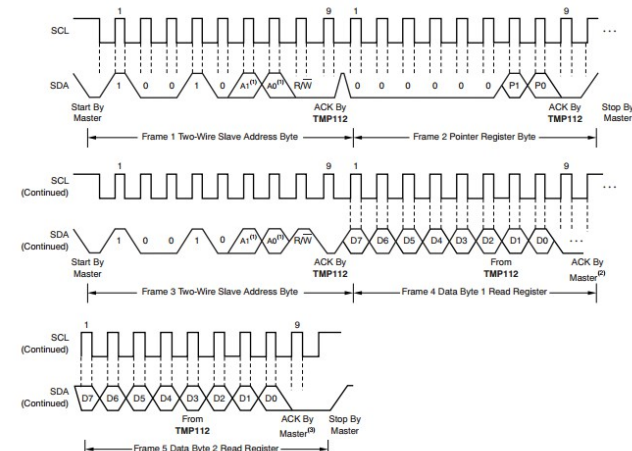
sales@ccmoss.com



TMP112

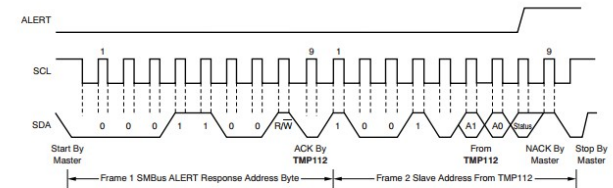
SBOS473C-MARCH 2009-REVISED OCTOBER 2014

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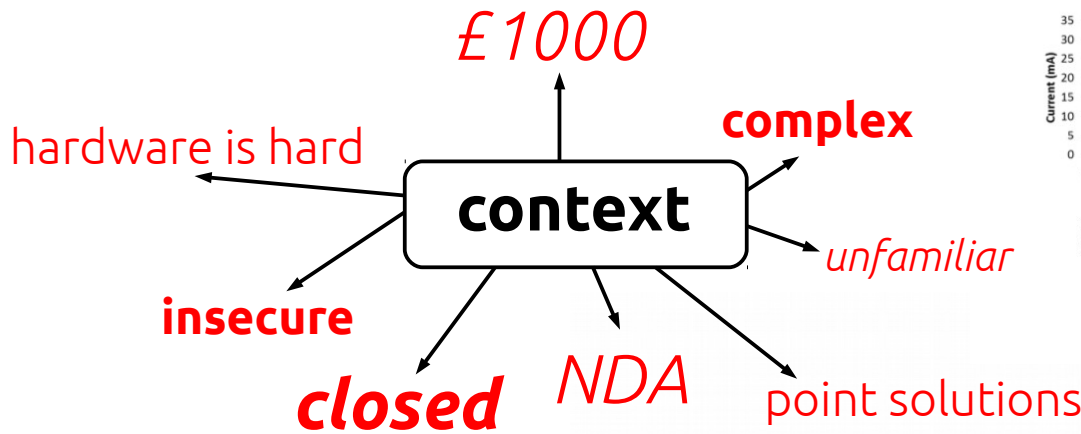
NOTE: (1) The values of A0 and A1 are determined by the ADD0 pin.  
 (2) Master should leave SDA high to terminate a single-byte read operation.  
 (3) Master should leave SDA high to terminate a two-byte read operation.

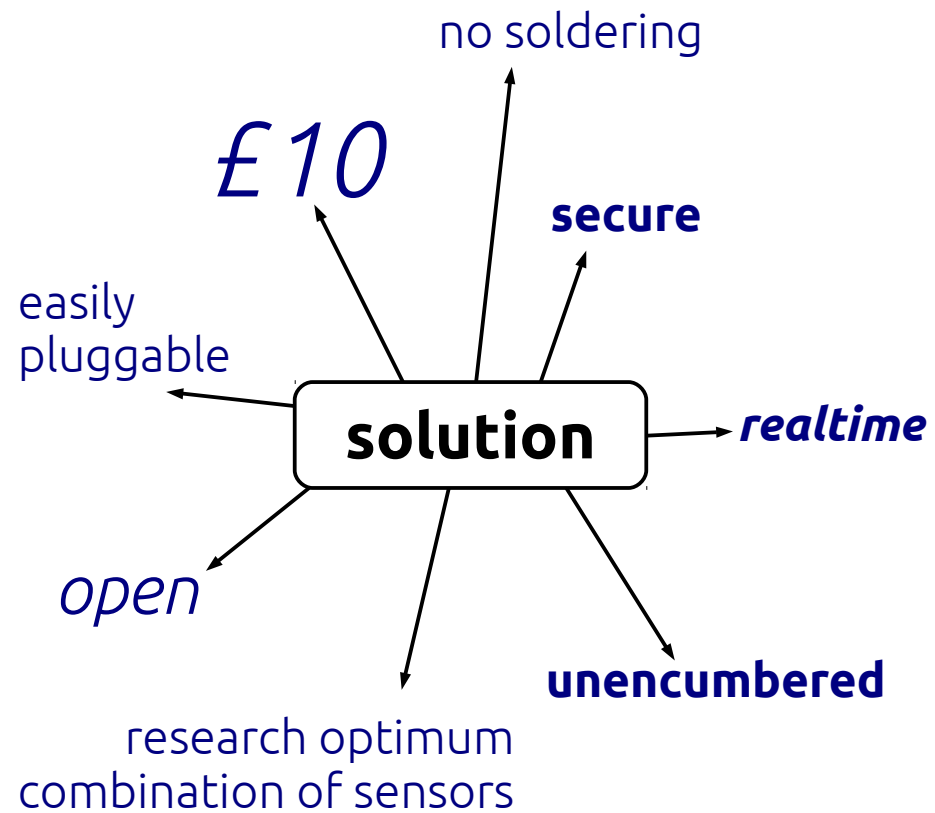
Figure 12. Two-Wire Timing Diagram for Read Word Format



NOTE: (1) The values of A0 and A1 are determined by the ADD0 pin.

Figure 13. Timing Diagram for SMBus ALERT

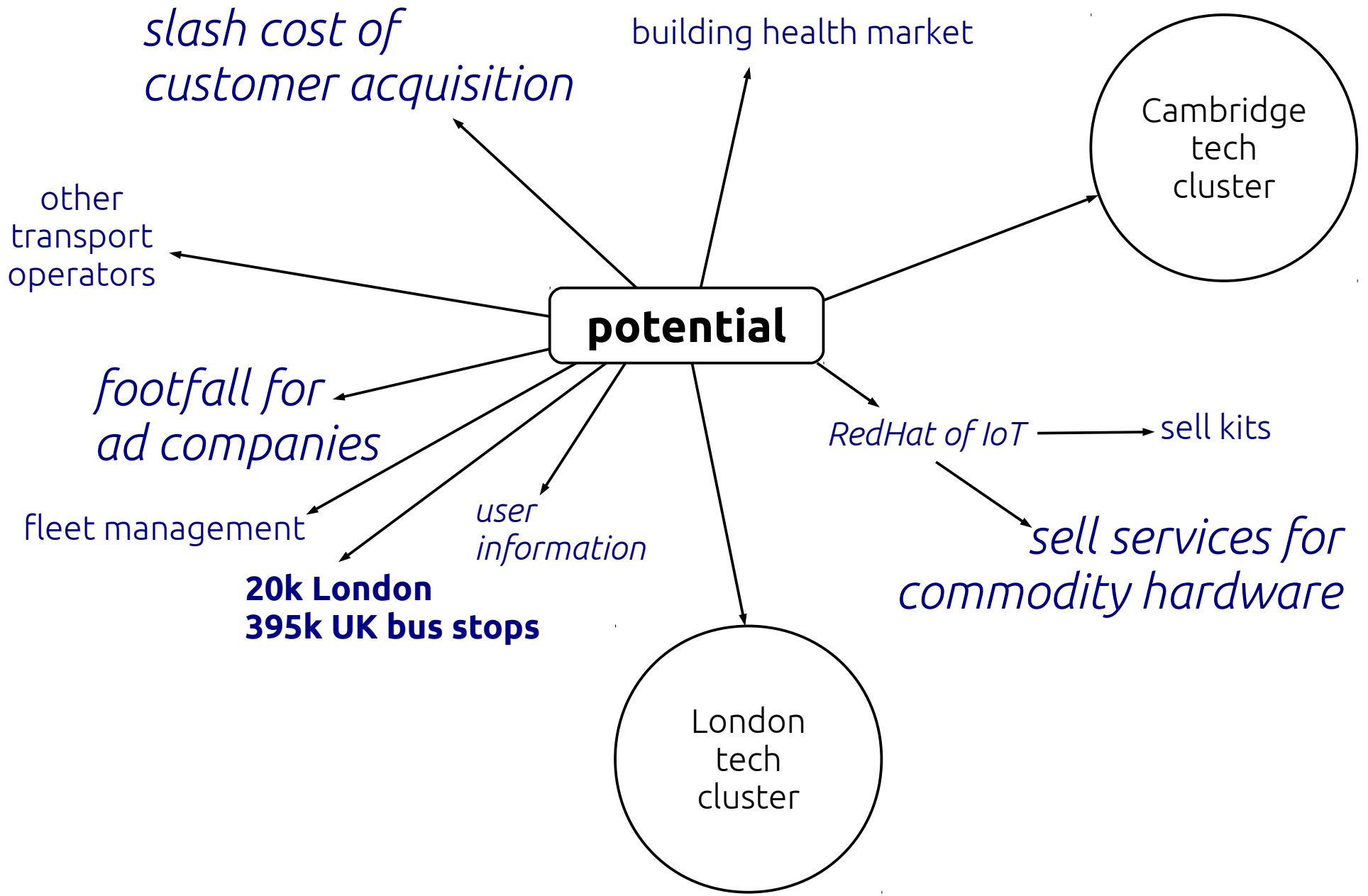




# Progress

Some elements done or happening now:

- Basic connector & stackability done
- Survey, comms, security research done
- Apache AES-GCM for microcontrollers ~4kB
- First radio test from bus shelters
- First large-scale ISM test (150+ units)
- Engaging with contract manufacturing



# Questions 2

Low-power ( $\mu\text{W}$ -class) sensors:

- What's the funkiest new sensor you have?
- Footfall/presence sensor should we add?
- What sick-building sensor should we add?

**hard**ware for IoT  
doesn't need to be **hard**

**footfall** for  
bus shelters  
and buildings

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the **glue** that binds  
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