

## Internship Seminar : Projects and Progress

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Swinburne University of Technology

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## Overview



- Router Project
  - Why Green?
  - Router Project Goals
  - Experiment
  - Results
- Netbook Project
  - Introduction
  - Goals
  - Experiment
  - Results
- Conclusion and Thanks

## Why Green?



### ■ Why Go Green?<sup>1</sup>

- Electricity generation more expensive
- PCs and monitors account for more than 40% of all ICT CO<sub>2</sub> emissions. Data Centres account only for 23%.

### ■ In Australia,<sup>2</sup>

- ICT sector generates 7.94 Million Tons of CO<sub>2</sub>
  - Similar to the Civil Aviation and Metal production industries
- DoD reports savings of \$5M per year, by just shutting down idle PCs.

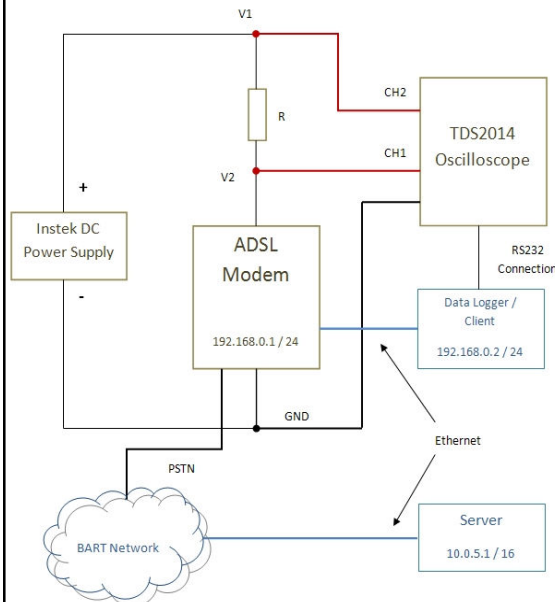
## Router Project



### ■ Goals of the project

- Analyse power levels
  - With different components active
  - With increasing amount of traffic
  - At Idle and Transmit phases
- Compare power usage of different routers
  - Linksys AG041 (12 W under max. load)
  - Cisco 837 (18 W under max. load)
  - Netgear DG834G (12 W under max. load)
    - Marketed as a Green Router

# Experiment



Python script to retrieve voltages from Oscilloscope

Data transfer between client and server using iperf with 2,10,25,50 and 100 parallel streams of traffic.

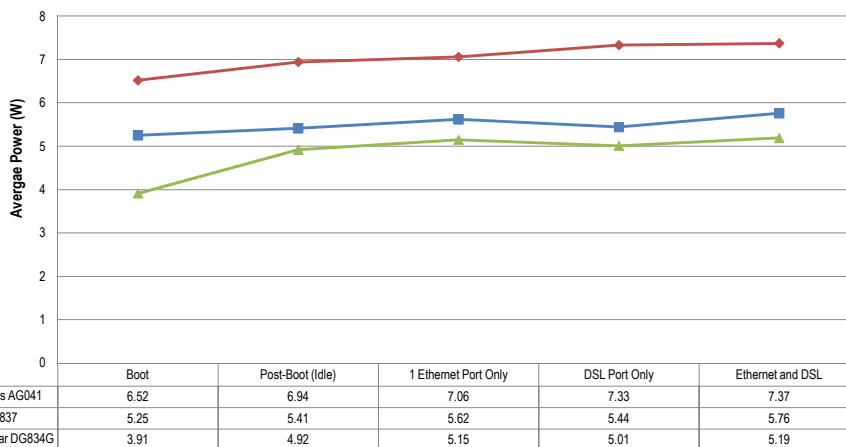
$$Power = \frac{(V1 - V2)}{R} \times V2$$

$$= I \times V2$$

# Results



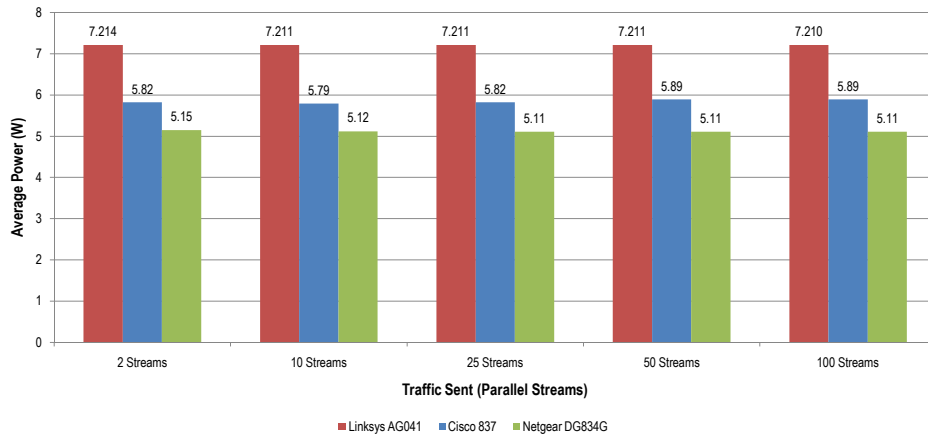
Power Usage with different components active



# Results: Data Transfer



Power Usage Comparison Chart



# Results: Idle and Transmit Phases



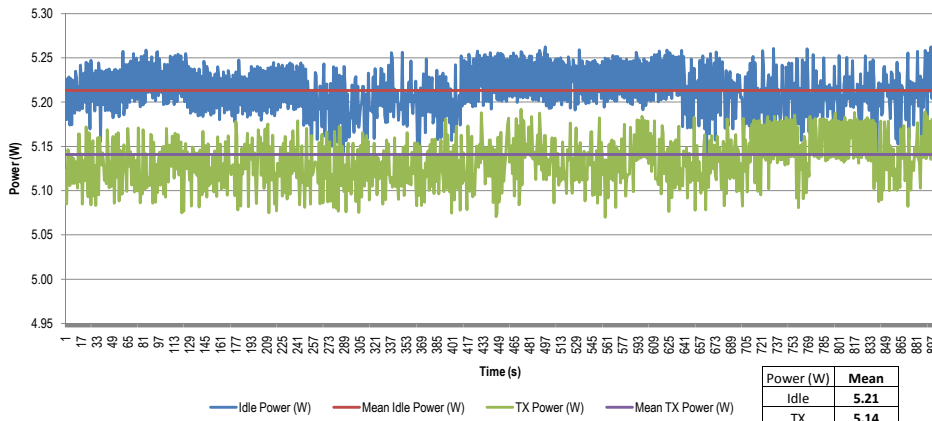
Linksys AG041  
Idle & Transmit Power Levels



## Results: Idle and Transmit Phases



Netgear DG834G  
Idle & Transmit Power Levels



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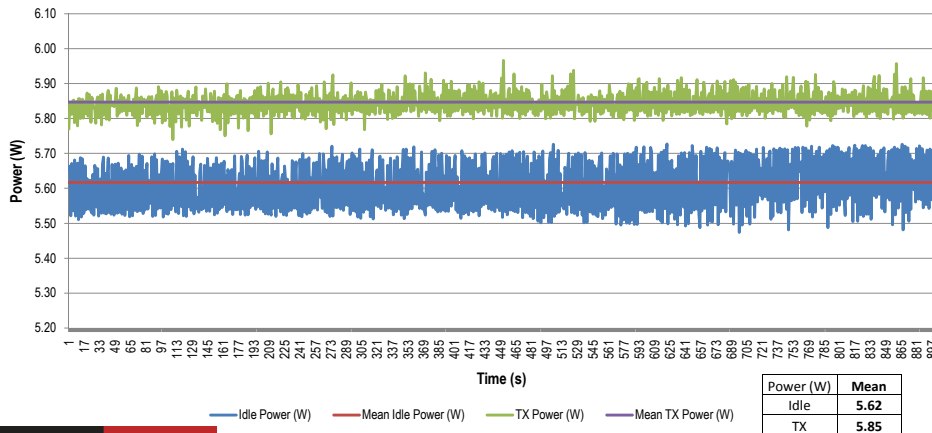
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## Results: Cisco 837 Idle and TX Phases



Cisco 837  
Idle & Transmit Power Levels



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## Conclusion



- Idle state consumes more power in two cases
- LEDs play an important role in power consumption
  - 7 W Router → \$11 every year
  - Saving 60 mW/h for 12 h → \$0.05 savings per year
  - Consider the possible savings with the millions of routers around the globe
- More green products on the market
  - Netgear and D-Link mainly
  - No CPU stepping technology

## Netbook Project



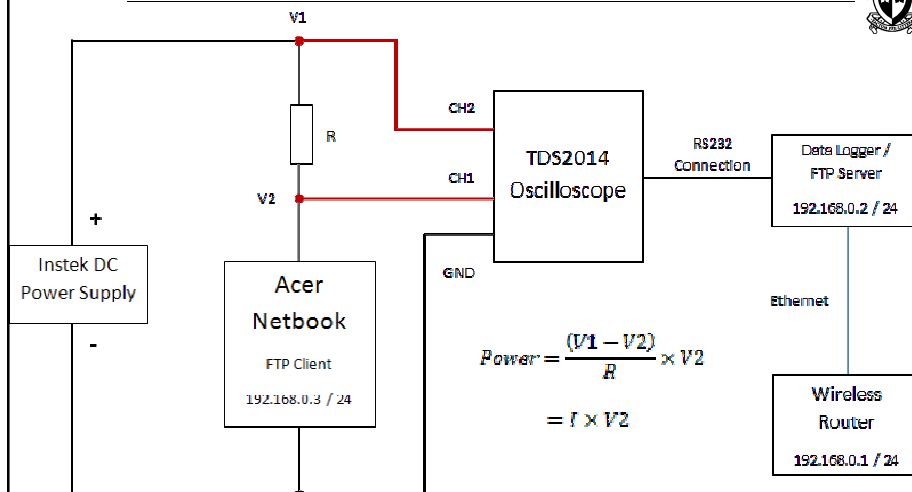
- Why Netbooks?<sup>3</sup>
  - Affordable and portable
  - Suitable for simple tasks such as web browsing and word processing
  - Low power usage → long battery life
  - Becoming mainstream devices
    - Shipments increased sevenfold in Q1 2009 as compared to Q1 2008 (8% of all PC shipments)
  - Acer holds 32% of netbook market

## Netbook Project



- Acer Aspire One Pro P531h (30 W under max load)
  - Intel Atom Processor N270 at 1.6 GHz (TDP 2.5 W)<sup>4</sup>
    - Mobile Core 2 Duo generates TDP 35 – 65 W
    - Ubuntu Netbook Remix 9.10 (Released October 2009)
- Goal: Determine the power usage of components
  - BIOS, Bootloader
  - Screen
  - Hard Disk Drive
  - Wireless
  - Processor

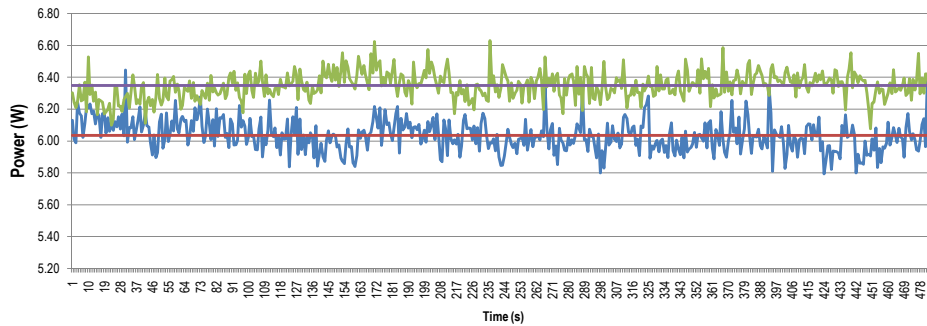
## Experiment



# Results: BIOS and Bootloader



BIOS & BootLoader Power Usage



Power (W)	BIOS	BootLoader
Min	5.794	6.077
Max	6.444	6.630
Mean	6.035	6.347
Std Dev	0.099	0.083



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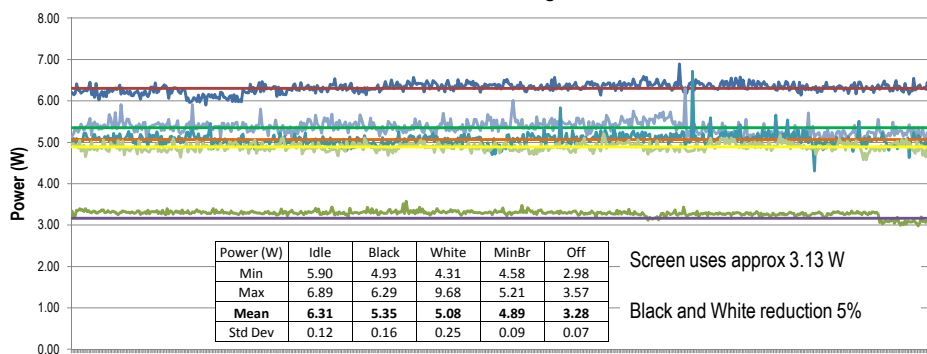
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# Results: Screen Tests



Screen Power Usage



Power (W)	Idle	Black	White	MinBr	Off
Min	5.90	4.93	4.31	4.58	2.98
Max	6.89	6.29	9.68	5.21	3.57
Mean	<b>6.31</b>	<b>5.35</b>	<b>5.08</b>	<b>4.89</b>	<b>3.28</b>
Std Dev	0.12	0.16	0.25	0.09	0.07

Screen uses approx 3.13 W

Black and White reduction 5%



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## Results : Screen



Monitor	Screen Size (inches)	Power consumption (Watts) 100% brightness level		% reduction
		Black screen	White screen	
AOC F19s	19	20.9	20	4.31%
AOC F22	22	41.6	40.4	2.88%
Asus MK241H	24	90.7	89.8	0.99%
Asus VH192C	19	20.8	20.2	2.88%
Asus VH232H	23	43.7	41	6.18%
Asus VW225T	22	37	36.3	1.89%
BenQ E2200HD	22	41.1	39.9	2.92%
BenQ G2400WD	24	44.6	44	1.35%
BenQ M2200HD	22	42.4	41.1	3.07%
Dell 2209WA	22	80	83	-3.75%

Yates, D., 2009. 'Black and White power consumption – 24 more LCD monitors tested', *Darren Yates blog*, weblog post, 23 September, viewed 8 February 2010, <<http://darrenyates.com.au/?p=1219>>

Darren Yates is a contributing editor for the Australian PC User Magazine.



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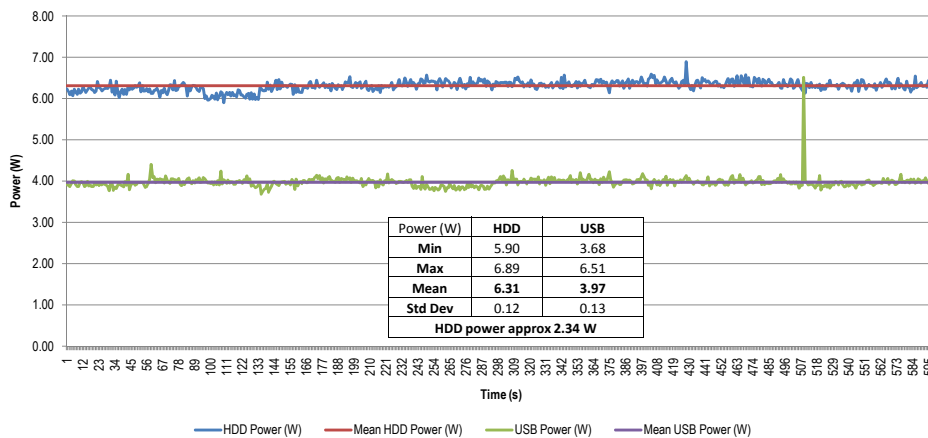
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## Results: HDD



Idle Usage with HDD and USB



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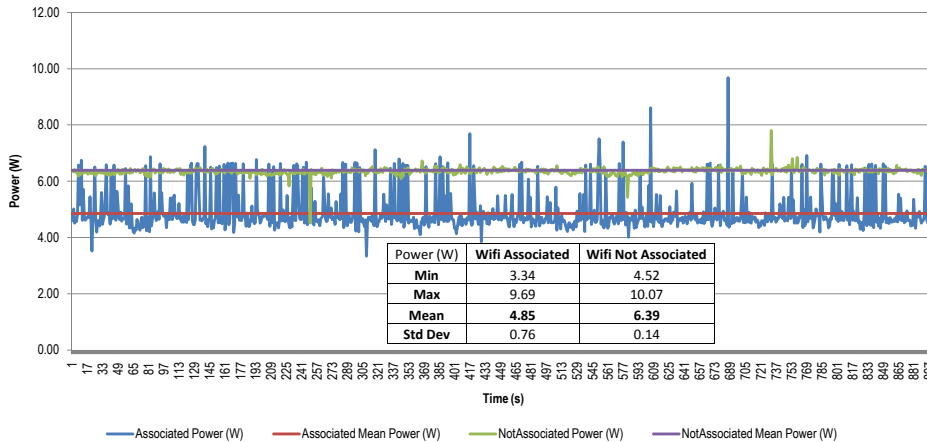
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# Results: Wireless Test



## Associated & NotAssociated Power Usage



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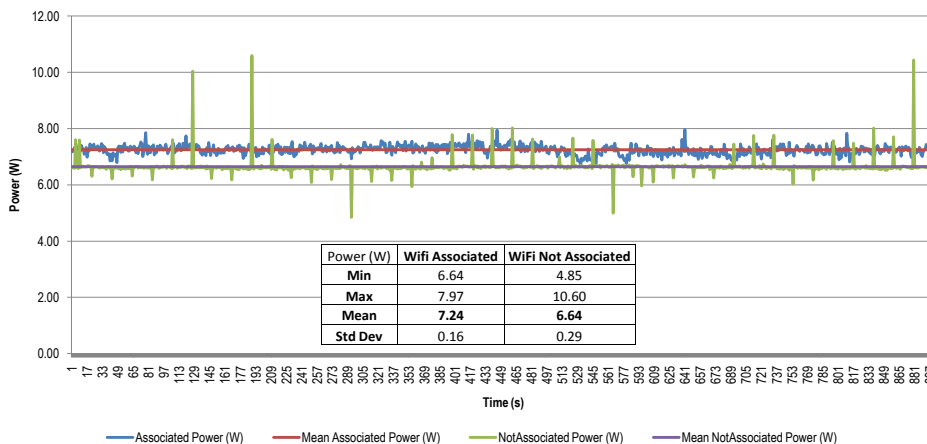
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# Results: Wireless Test (New drivers)



## Associated & NotAssociated Power Usage



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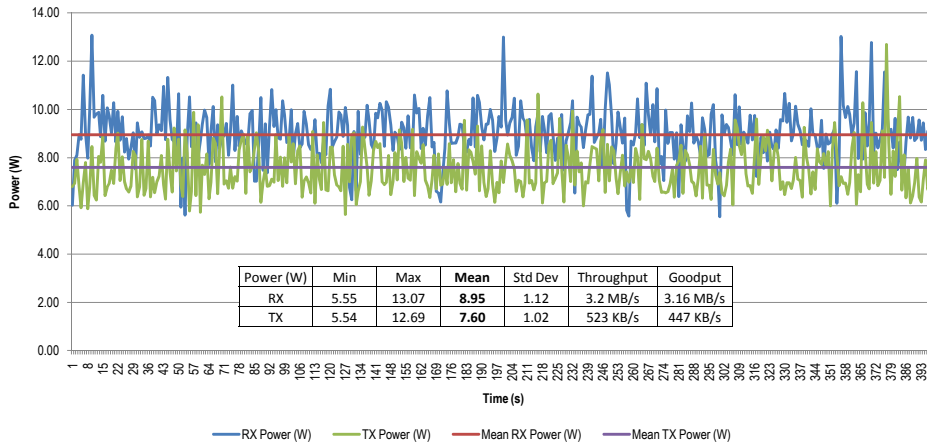
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# Results: Wireless Test (Rx & Tx)



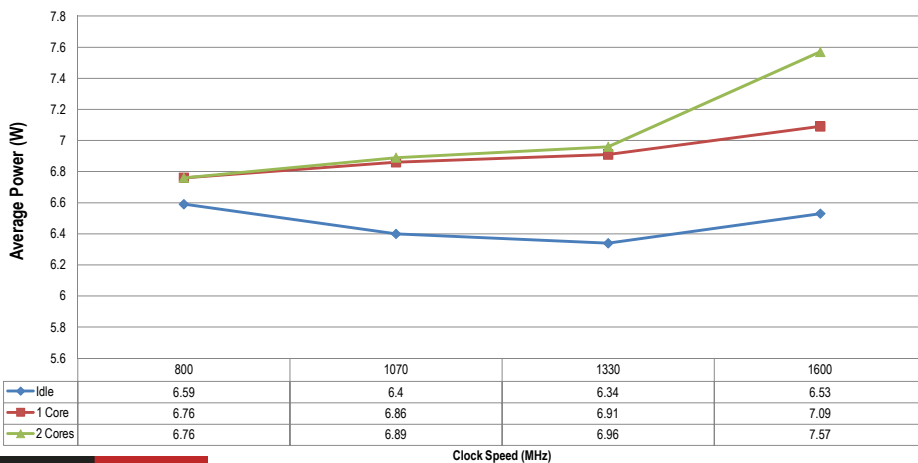
RX and TX Power Usage



# Results: Processor



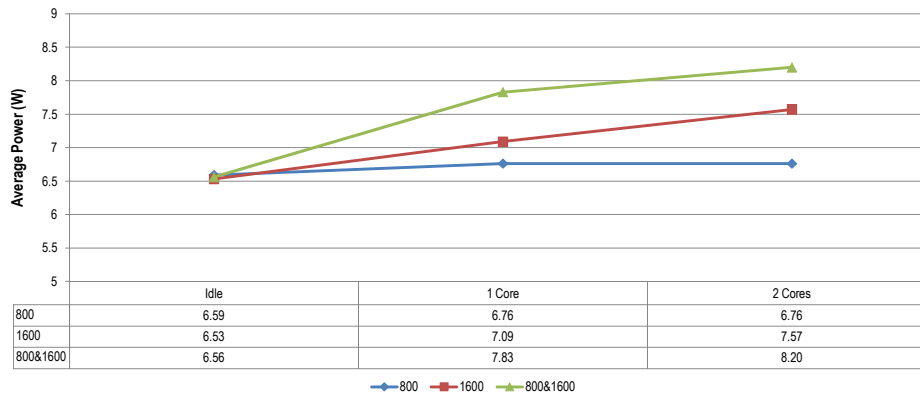
Idle and Loaded Cores Power Usage



## Results: Different core speeds



Idle and Loaded Cores Power Usage  
 First Core at 800 MHz  
 Second Core at 1.6 GHz  
 (Green Graph)



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## Conclusion & Future Work



- Having a dark background does not conserve power with newer LCD displays.
- LCD Display and HDD main power sinks, at 49% and 37%.
- Drivers play an important role in power usage
- Using only 1 core does not result in considerable power saving
- Future work will look at
  - Power draw due to HDD read/write operations / SSDs
  - Graphics card power consumption
  - Comparing Windows and Linux power usage
  - Looking at how much power saving can be realised through clever management of processor speed



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## Acknowledgments



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## Questions ?

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