



# Exploring Temperature and 5G Network Speeds

Andrew Topmiller

College Park Scholars – Science & Global Change Program  
Computer Engineering  
atopmill1@umd.edu  
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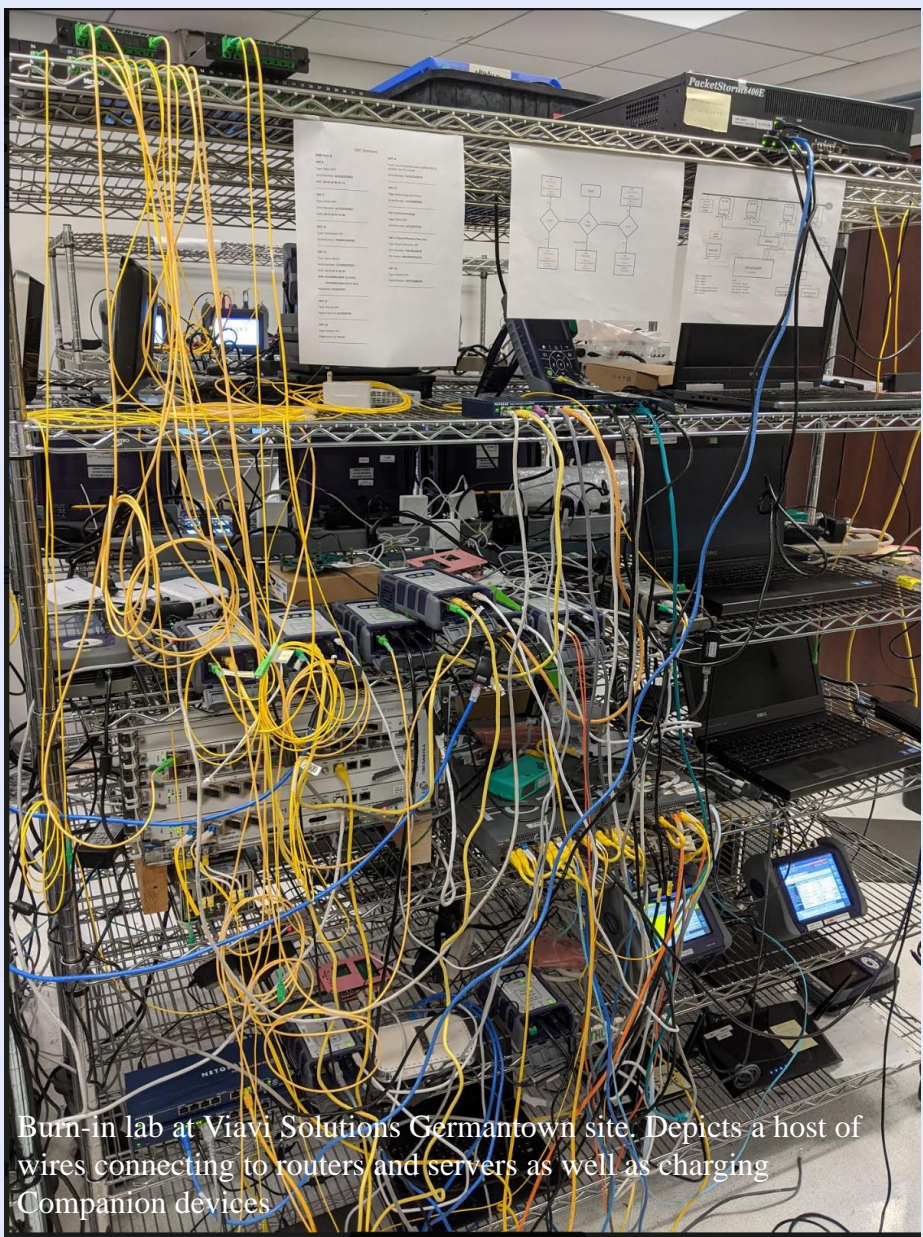


## What is a 5G Network:

- 5<sup>th</sup> generation of mobile wireless systems
- Send and receive data
- Allows access to the internet through different mediums
  - Ethernet
  - Wi-Fi
  - PON (Passive Optical Network)
    - Light transmits data through optical cables
- Viavi Companion
  - Handheld
  - Testing and documentation of network environments over the three interfaces above



EMI chamber similar to the one I used at Viavi Solutions Germantown site. Shows the battery on the left and the shielded room on the right.



Host in lab at Viavi Solutions Germantown site. Depicts a host of wires connecting to routers and servers as well as charging companion devices.

## Testing the Limits

- Buyer required the Viavi Companion for field testing at 50<sup>0</sup> Celsius.
- Battery needs to last at least 2 hours while running network speed tests
- Components need to be in a safe operating temperatures

## Site Information:

Viavi Solutions Inc.

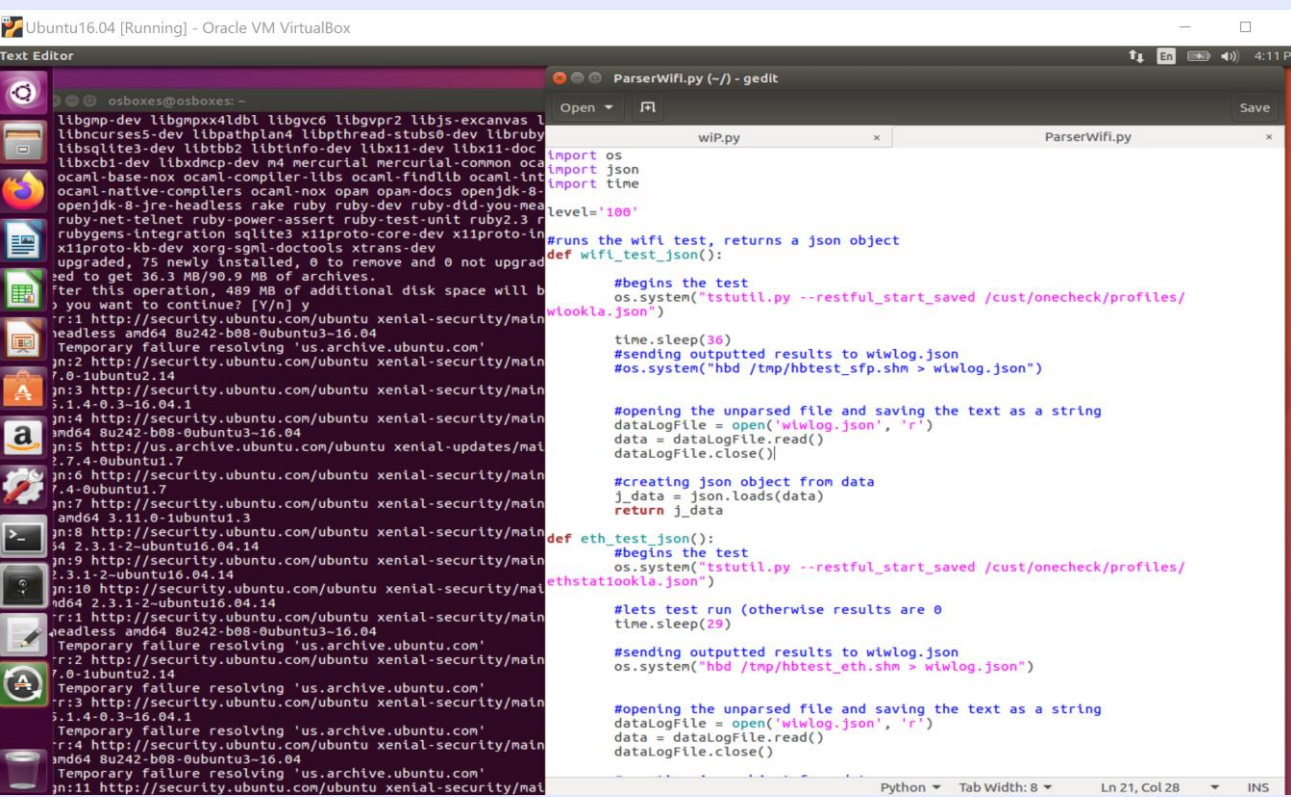
Address: 20250 Century Blvd

Supervisor: Hans-Joerg Wolf

Mission: To help service providers and enterprises deploy, maintain, optimize and evolve complex networks worldwide <sup>1</sup>

## What did I do?

- Wrote python scripts to run Wi-Fi, Ethernet, and PON tests on the Companion at different conditions
- Ran at 10, 20, 30, 50 degrees Celsius, 40% and 80 % humidity
  - Tested battery life and processor/FPGA temperatures
  - Simulated in both Temperature and EMI Chambers
- Designed script to control Companion's personal fan



Example code from script used to execute Wi-Fi tests in python on Oracle VM Virtualbox

## What was concluded?

- Companion consistently lasted the full two hours
  - Longest battery life from 10<sup>0</sup> C to 30<sup>0</sup> C
  - PON and Ethernet throughput average 700-945 mbps
  - Wi-Fi throughput significantly lower (~100 mbps)
- EMI Chamber
  - Ethernet and Wi-Fi near max (945 mbps)

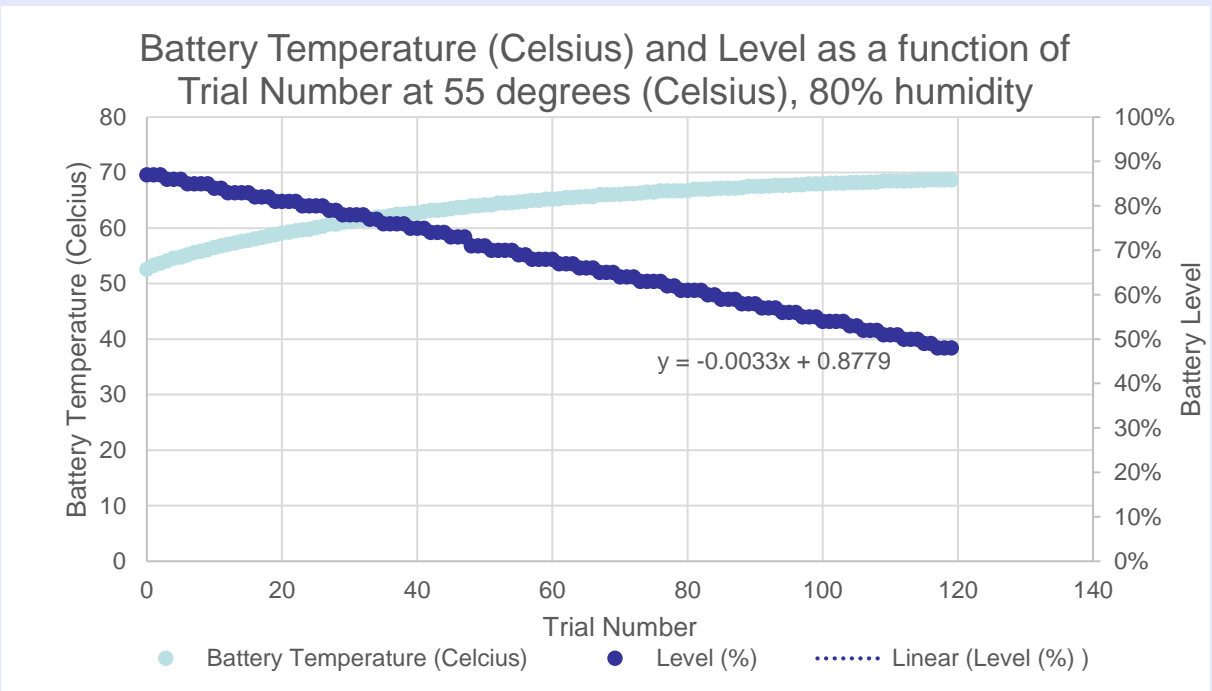
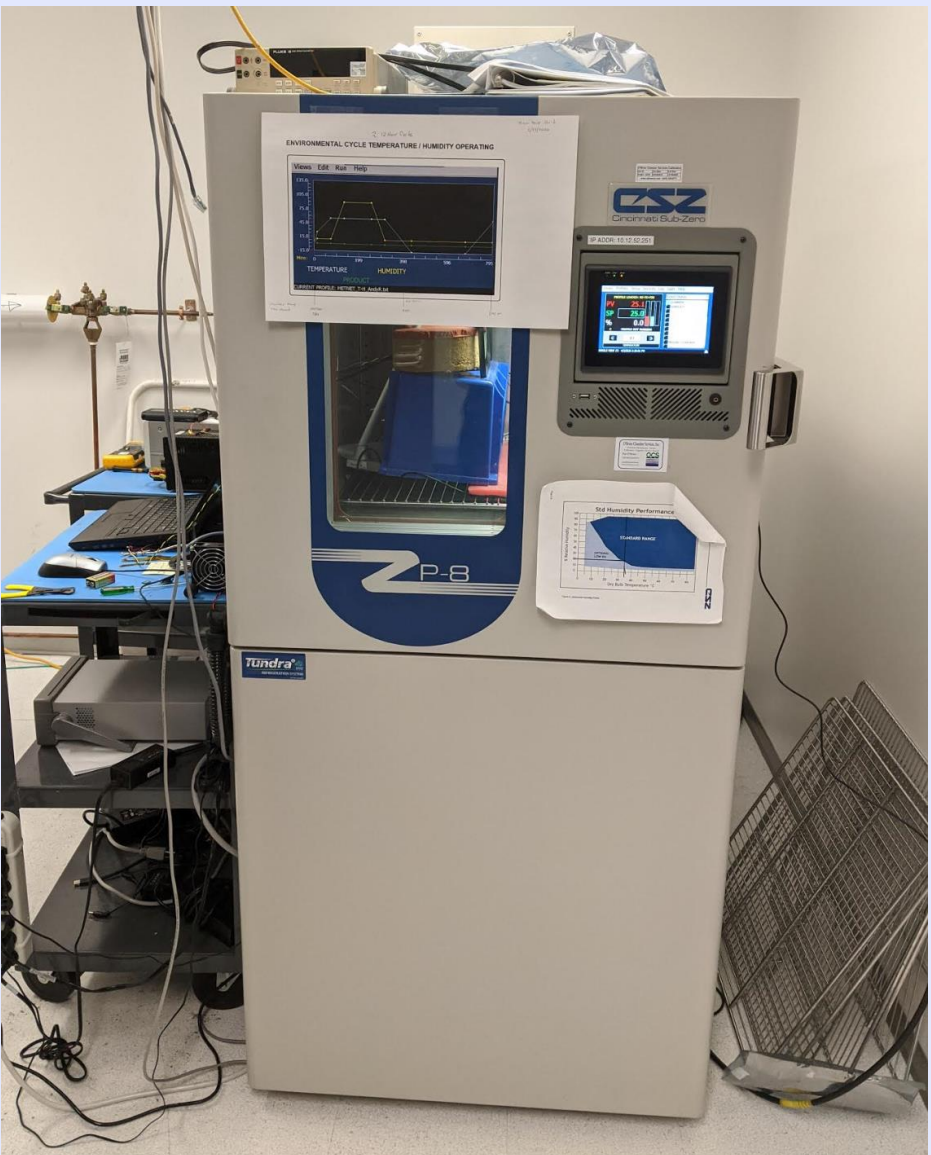
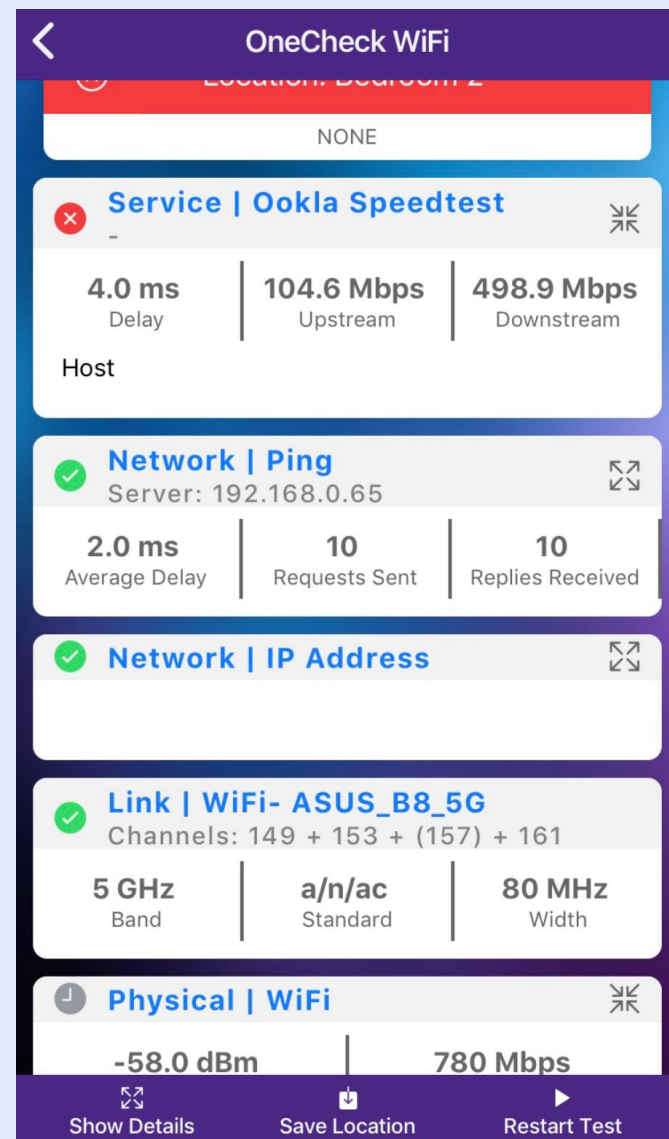


Image from Viavi Ethernet and GPON Test Results: battery level (purple) and temperature (blue) as a function of time over 2 hours at 55 degrees Celsius



CSZ Z Plus Temperature and Humidity Chamber at Viavi Solutions Germantown Site



Screenshot of app used to run network speed tests on the Viavi Companion

## How?

- Scripts executed system commands in Linux shell on a virtual machine
- Input redirection of results
  - Formatted in JSON to be converted

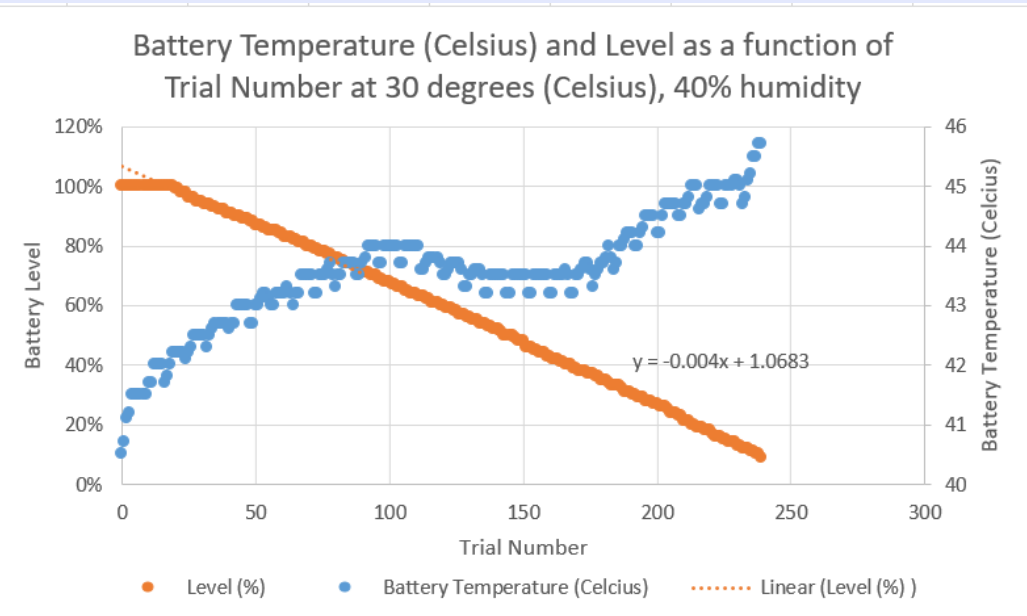


Image from Viavi Ethernet and GPON test results: full battery life test at 30 degrees Celsius and 40% humidity

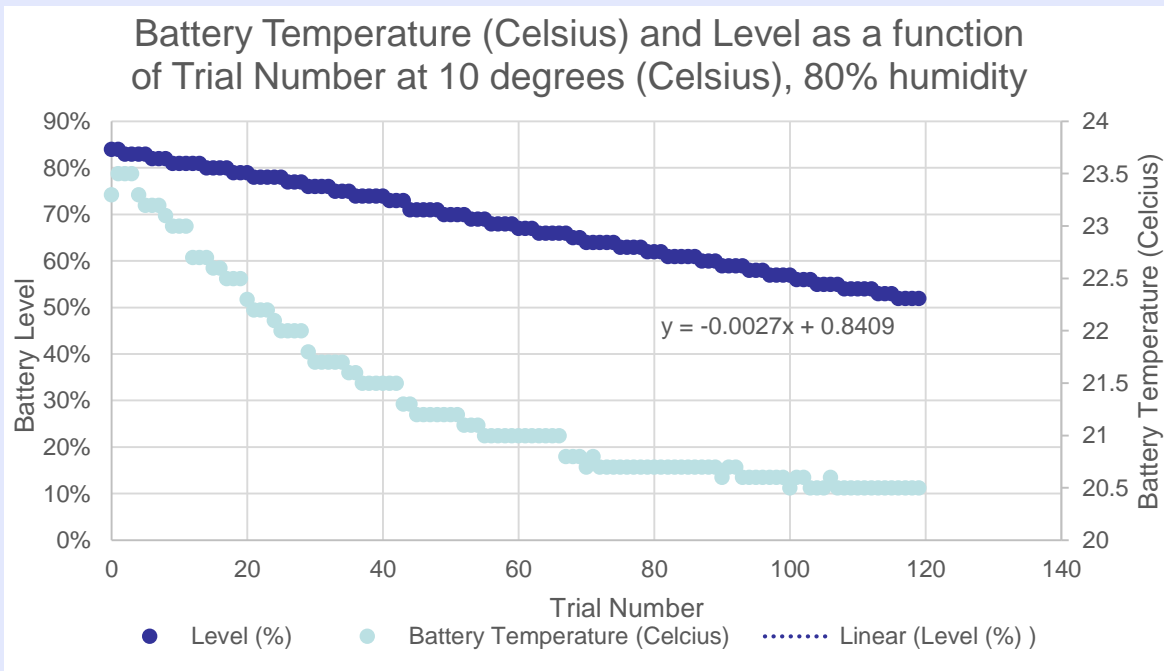


Image from Viavi Ethernet Test Results: battery level (purple) and battery temperature (blue) as a function of time over 2 hours, at 10 degrees Celsius and 80 percent humidity

## Moving forward

- Companion successfully able to run for 3 to 4 hour periods
  - At 60<sup>0</sup> PON overheats
- Emi chamber
  - Best for simulating ideal conditions
- Future models have fans, other components
  - Model without fan runs for 3 to 4 hours
  - Using similar scripts, easy to test battery life for future models



## Acknowledgments:

I would like to thank Professors Thomas Holtz Jr. and John Merck as well as the Science and Global Change Curriculum for the knowledge and advice they gave as it was helpful for completing this experience. I would also like to acknowledge my supervisor Hans-Joerg Wolf. Throughout my internship he provided insight on the results of my data as well as assistance when problems arose with hardware or software.

## Bibliography

1) About Us. (2020, March 9). Retrieved from <https://www.viavisolutions.com/en-us/corporate/about-us>

