Heavy Trucks and Electronic Logging Devices:

What Could Go Wrong?

Corey Thuen
@CoreyThuen

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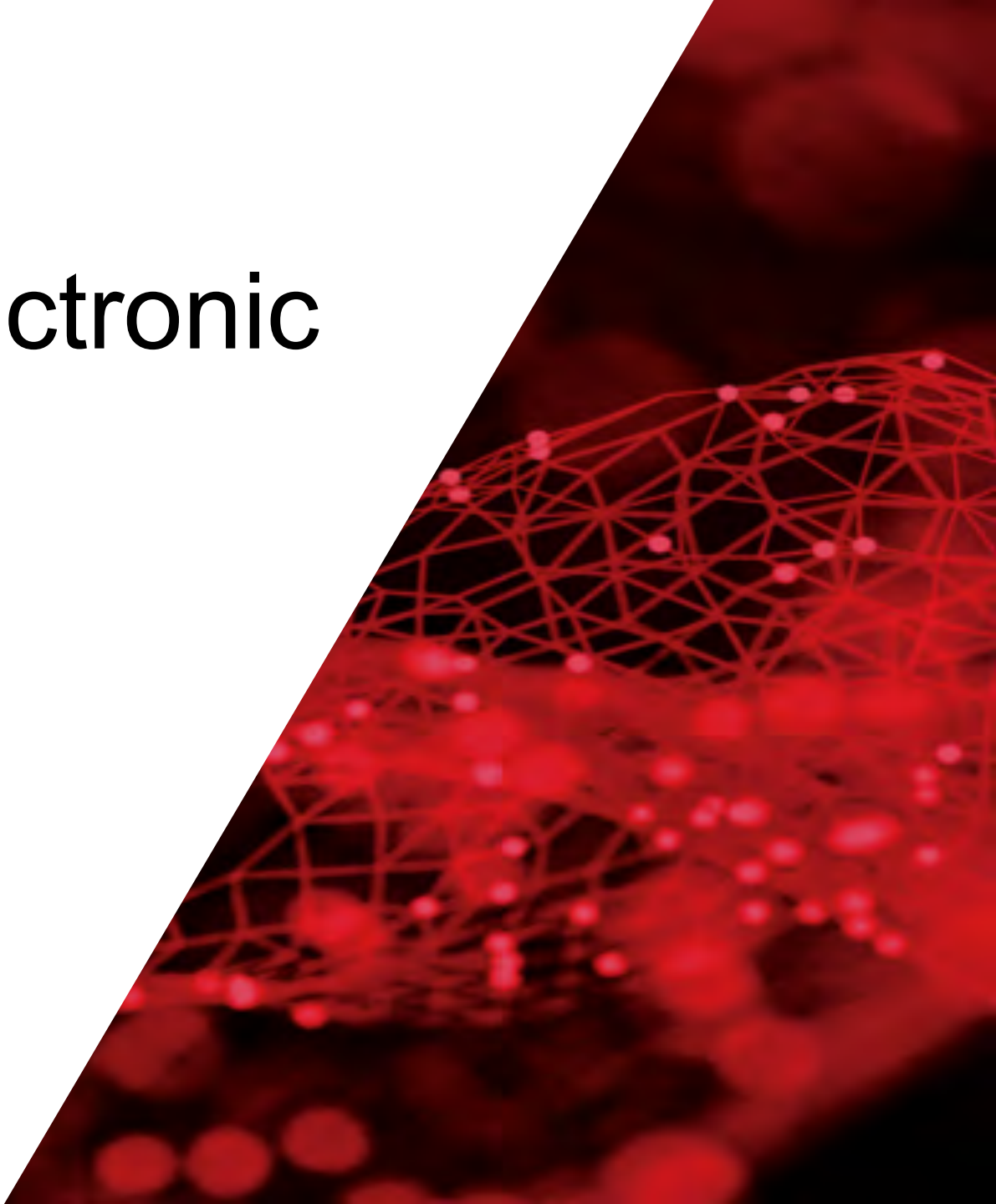


Talk Overview

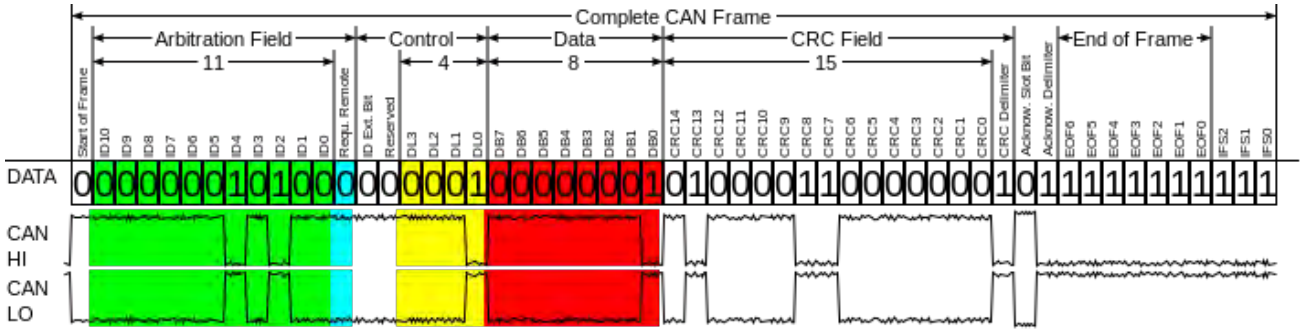
- CAN primer
- Heavy trucking
- ELD analysis
- Cyber truck challenge
- Summary of findings (This work is high level on purpose)

A Very Brief CANBus Primer

Arbitration ID

8 byte (max) payload

e.g. 0x310#FFFF0102



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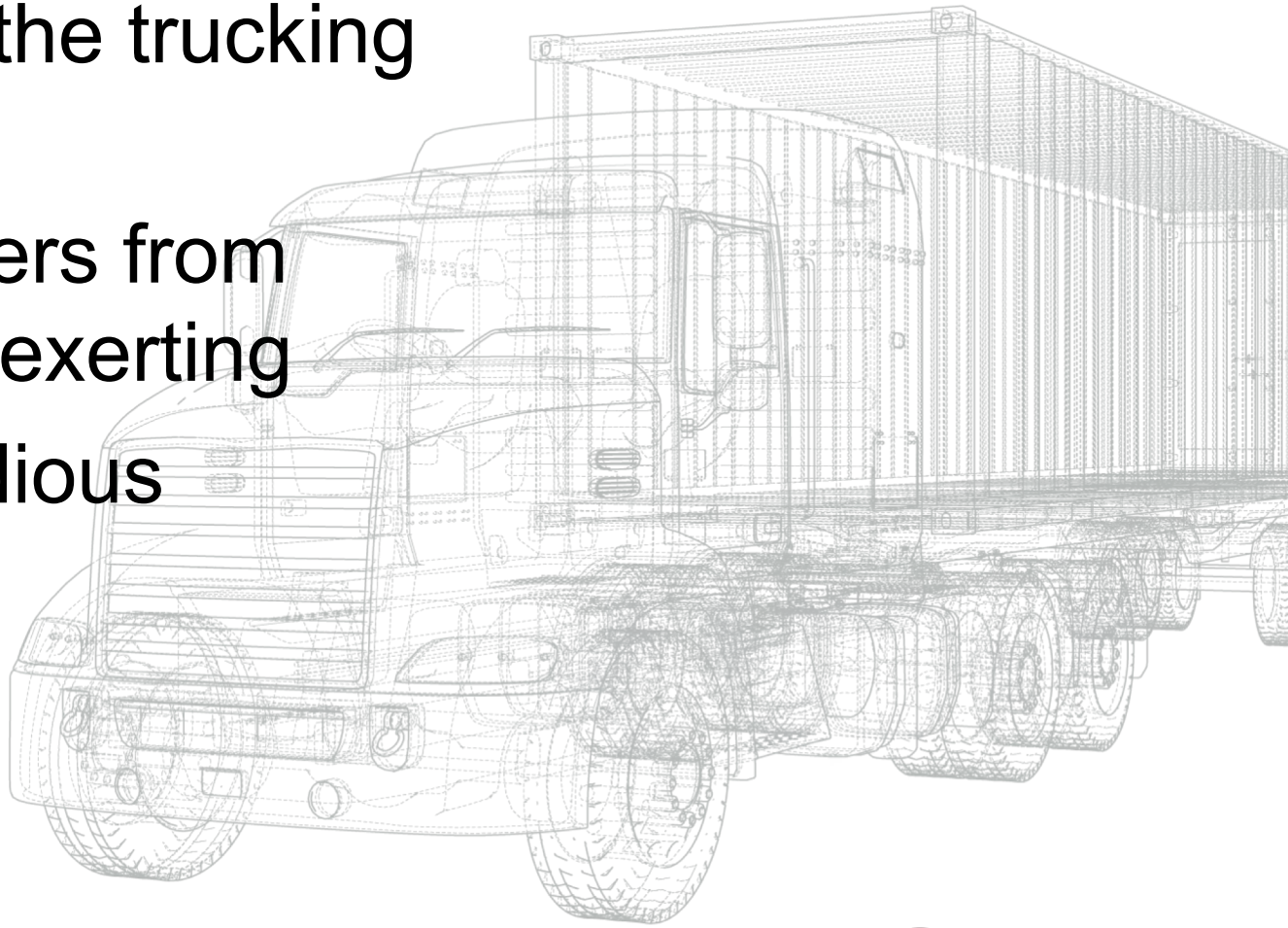
Trucking Overview

- US ***heavily*** depends on the trucking industry
- Regulations prevent drivers from driving too long and overexerting
- Checking logbooks is tedious and they can be falsified



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PEOPLE ARE GOING
AROUND OUR REGULATION?
IT'S OK, WE ADDED MORE
imgflip.com

ELD Requirements

- 444 pages of awesome
- Effective December 2017

Insert Quality Assurance Requirements Here

- The identity of the person who performed or led the test
- The outcome of the test (pass/ fail)
- Any comments related to the test

- For each failed test procedure:
  - The identification of all tests that will need to be re-run as a result of the deficiency/defect.

Testing Procedures

1.11 Quality Assurance

Insert the Quality Assurance program here.

1.12 Automated Testing Process

No automated testing will be done as part of the ELD procedures testing.

1.13 ELD Test Procedures

Individual test procedures will be grouped according to requirement type in the following chapters:

- Chapter 1: Accounts, Inputs and Vehicle Interface
- Chapter 2: Processing, Monitoring and Recording
- Chapter 3: Outputs and Data Transfer

Technical Testing Approach

1.14 ELD Procedures Testing Overview

Testing of the ELD procedures will be a step-by-step completion of the test procedures which have been developed to verify the requirements in the RTM.

1.15 Objectives

Testing is to be used to verify conformance of the ELD with the FMCSA requirements.

1.16 Test Items

1.16.1 General

When necessary, Commercial Motor Vehicles (CMVs) will be used for bus interfaces.

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Actually, There Is ***Some*** Good in 444 Pages…

_Plan_and_Procedures_10-17-2016_WORD.docx 123 / 444

registration.

(3)ELD Providers will be required to complete a test procedure to ensure their data is properly formatted before they can begin submitting driver's ELD data to the FMCSA server.

(c)ELD data transmission must be accomplished in a way that protects the privacy of the driver(s).

(d)At roadside, if both the vehicle operator and law enforcement have an available data connection, the vehicle operator will initiate the transfer of ELD data to an authorized safety official. In some cases, an ELD may be capable of converting the ELD file to an XML format using an FMCSA-provided schema and upload it using information provided in the WSDL file using SOAP via RFC 7230, RFC 7231, and RFC 5246, Transport Layer Security (TLS) Protocol Version 1.2 (incorporated by reference, see § 395.38).

4.10.1.2 Wireless Data Transfer Through E-Mail

(a) The ELD must attach a file to an email message to be sent using RFC 5321 Simple Mail Transfer Protocol (SMTP) (incorporated by reference, see § 395.38), to a specific email address, which will be shared with the ELD providers during the technology registration process.

(b)The file must have the format described in section 4.8.2.1 of this appendix and must be encrypted using the Secure/Multipurpose Internet Mail Extensions as described in RFC 5751 (incorporated by reference, see § 395.38), and the RSA algorithm as

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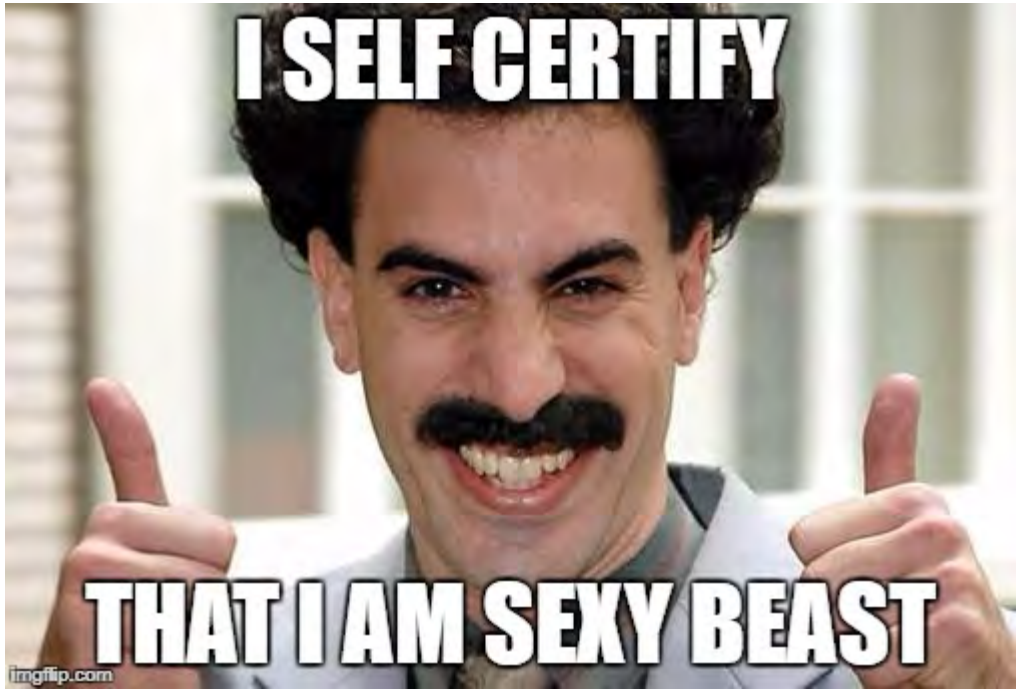
You Might Say:

“Wow! 444 pages of requirements. That must be really difficult to get qualified. How do I do it?”

Self-Certification!



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Over 70 Registered ELDs

United States Department of Transportation

About DOT | Our Act

FMCSA
Federal Motor Carrier Safety Administration

LOGIN |

Registered ELDs

The listed devices are self-certified by the manufacturer. The Federal Motor Carrier Safety Administration does not endorse any electronic logging devices. Click **here** to return to the homepage.

View

Device Name	Model Number	Software Version	ELD Identifier	Image	User Manual	Company	Contact Company (Phone)	Contact Company (Email)	Company Website
TRUXBOX ELD	TTB1.01	4.0.0	TTB1.01	ELD2.png	TruxTrax - Truxbox ELD User manual1.07.pdf	TruxTrax inc	514.704.5879	support@truxtrax.com	https://www.truxtrax.com
E-Log Plus	ELP0100	Build 1.0.1712.7443	ELP0100	Product Image-HOS-Geometris.jpg	E-log Plus HOS User Guide.pdf	E-Log Plus	8778434773	info@e-logplus.com	www.e-logplus.com
HOS247 ELD	FLT2	2.2 and up	ELD247	HOS247_ELD.png	HOS247_ELD_userguide.pdf	HOS247 LLC	415-839-9977	hello@hos247.com	www.hos247.com
ELD Chrome	Cab-Mate Open	4	CMOP01	CabMate Open.jpg	ELD Instruction Booklet.pdf	Pedigree Technologies, LLC	855-838-6941	eld@pedigreetechnologies.com	http://www.eldcertified.com
ELD Chrome	Cab-Mate Connect	4	CMCN01	CabMate Connect.jpg	ELD Instruction Booklet.pdf	Pedigree Technologies, LLC	855-838-6941	eld@pedigreetechnologies.com	http://www.eldcertified.com
ELD Fleet	G3000	1.0.1625.6584	ELDFLT	ELDFLeet.jpg	GPS Trackit ELDFleet User Guide.pdf	Global Tracking Communications, Inc.	877-628-7404	FleetAdvisor@GPSTrackit.net	http://gpstrackit.com/eld-fleet/
ELD Fleet	L4000	1.0.1625.6584	ELDFLT	ELDFLeet.jpg	GPS Trackit ELDFleet User Guide.pdf	Global Tracking Communications, Inc.	877-628-7404	FleetAdvisor@GPSTrackit.net	http://gpstrackit.com/eld-fleet/
ONE20 F-ELD for Android	PT30	1.1 or higher	ONE20A	ONE20_F-ELD_img.png	ONE20_F-ELD_User_Guide_v1.1.pdf	ONE20, Inc.	1-888-986-6320	f-eld@one20.com	www.ONE20.com
HCSSELD	GEO83A	1.0.1702.6723	GEO83A	eLogsSheet.png	HCSS eLogs User Guide.pdf	HCSS	7132704000	sales@hcss.com	www.hcss.com
Qv21 ELD Compliance Module	Qv21ELD	V2.26	TN0262	Qv21_ELD_CM.png	Qv21_ELD_UG.pdf	Qv21 Technologies, Inc.	855-853-7821	Info@qv21.com	www.qv21.com

1 2 3 4 5 6 7 8

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Still Under Contention

New bill introduced to house:
H.R. 3282, the ELD Extension Act of 2017

"Many significant technological concerns remain unresolved, including certification of devices, connectivity problems in remote locations, cyber vulnerabilities, and the ability of law enforcement to access data."

ELD Acquisition

- ELDs from three manufacturers
- Consumer off the shelf
- Suppliers chosen at random

Off to a Great Start…

https://app.bigroad.com/mobile-signin-redirector?emailAddress=foo@example.com&password=xaffbm

Hello,

I've invited you to join Foo Company on BigRoad. Please follow the instructions to get started.

Thanks,

Step 1

Download the BigRoad mobile app from:

https://get.bigroad.com

Step 2

Sign into the app by tapping this link on your phone:

https://app.bigroad.com/mobile-signin-redirector?emailAddress=foo@example.com&password=xaffbm

If the link doesn't work, you can sign into the BigRoad app using the following email address and password:

Email address: foo@example.com

Password: xaffbm

Once you're signed in, you can change your password by tapping the menu icon, selecting Settings and then My Profile.

BigRoad THE ESSENTIAL APP FOR DRIVERS & FLEETS

FREE TRIAL FOR FLEET OPERATORS SIGN IN

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Hardware Analysis

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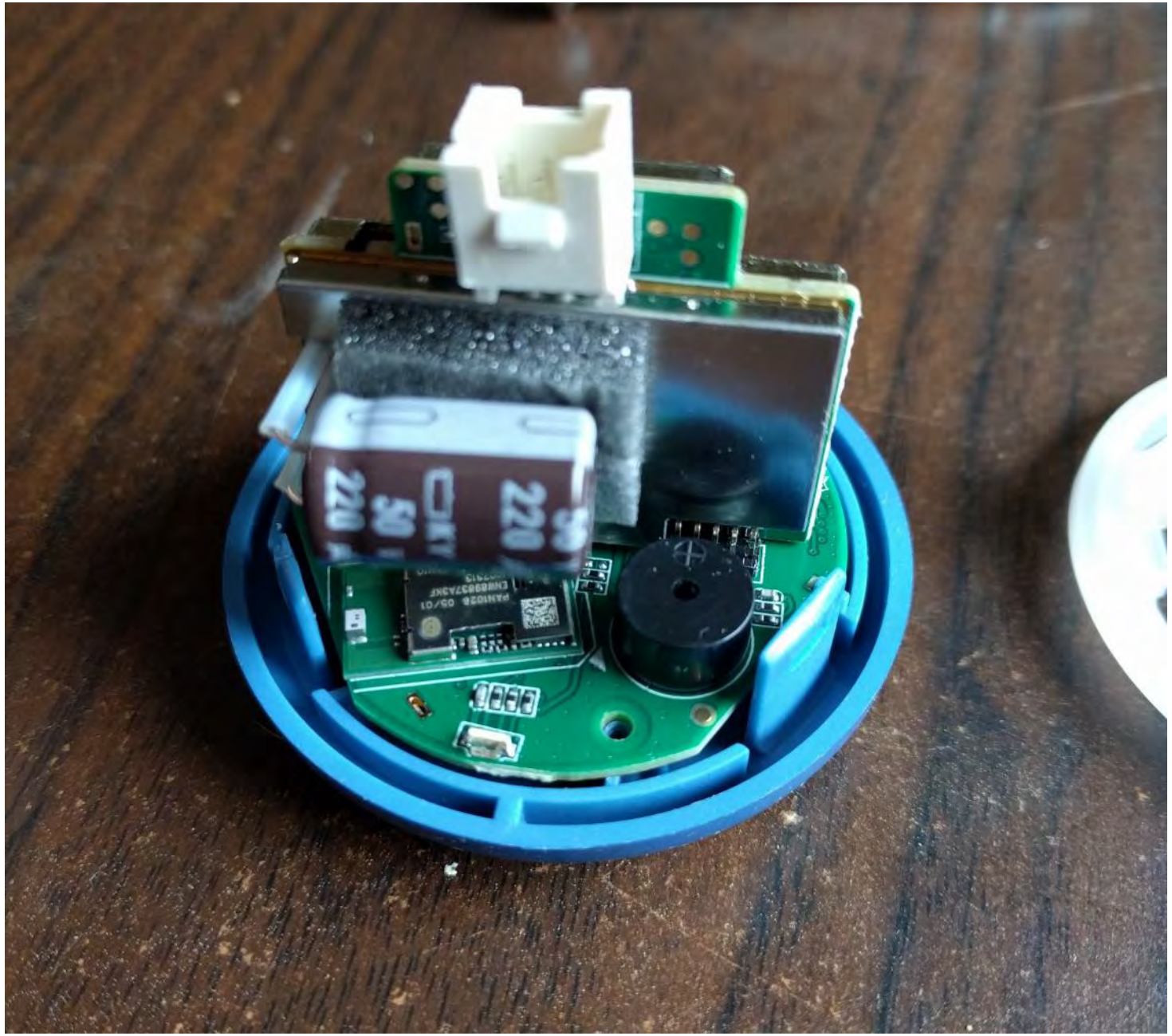

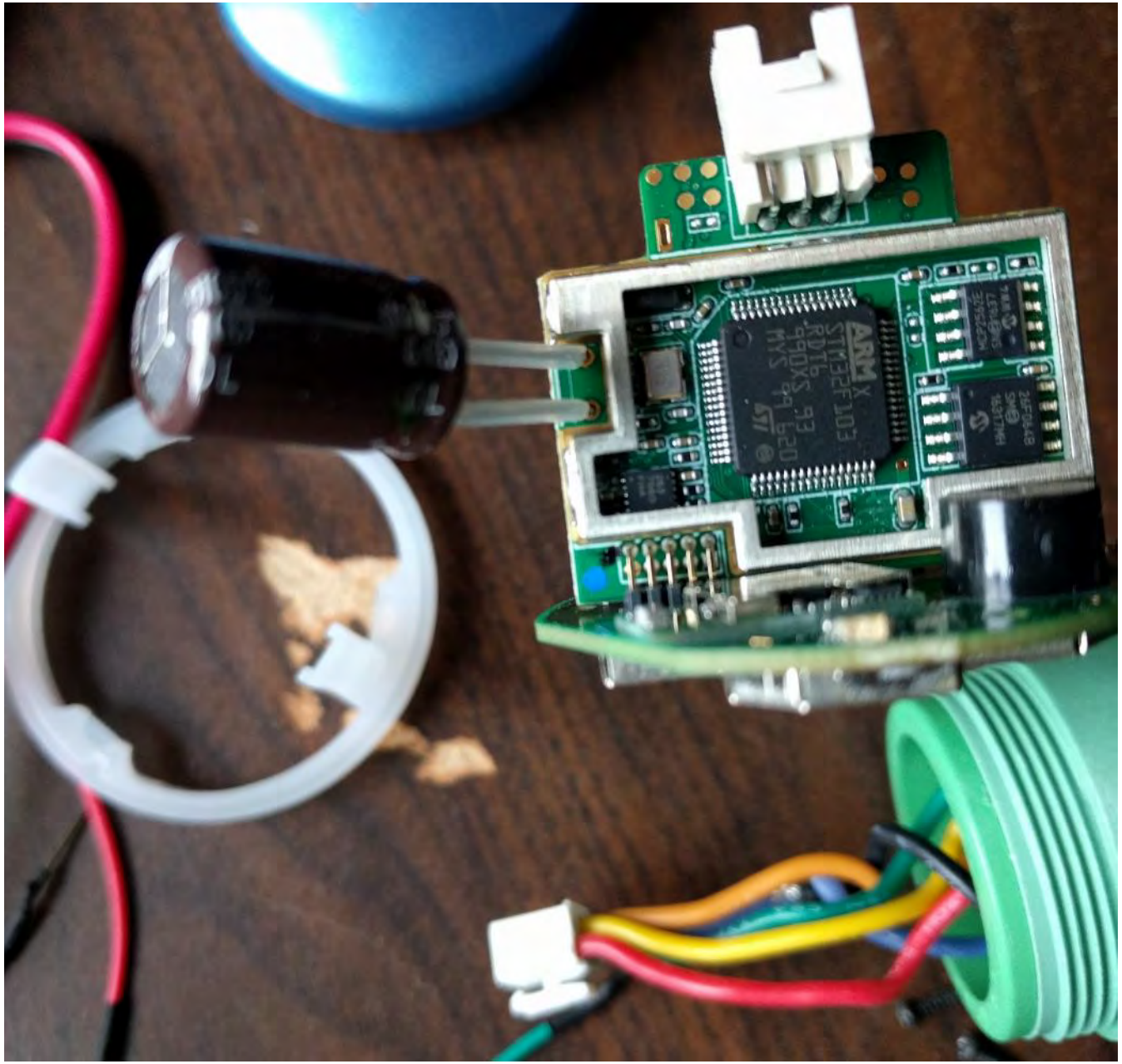
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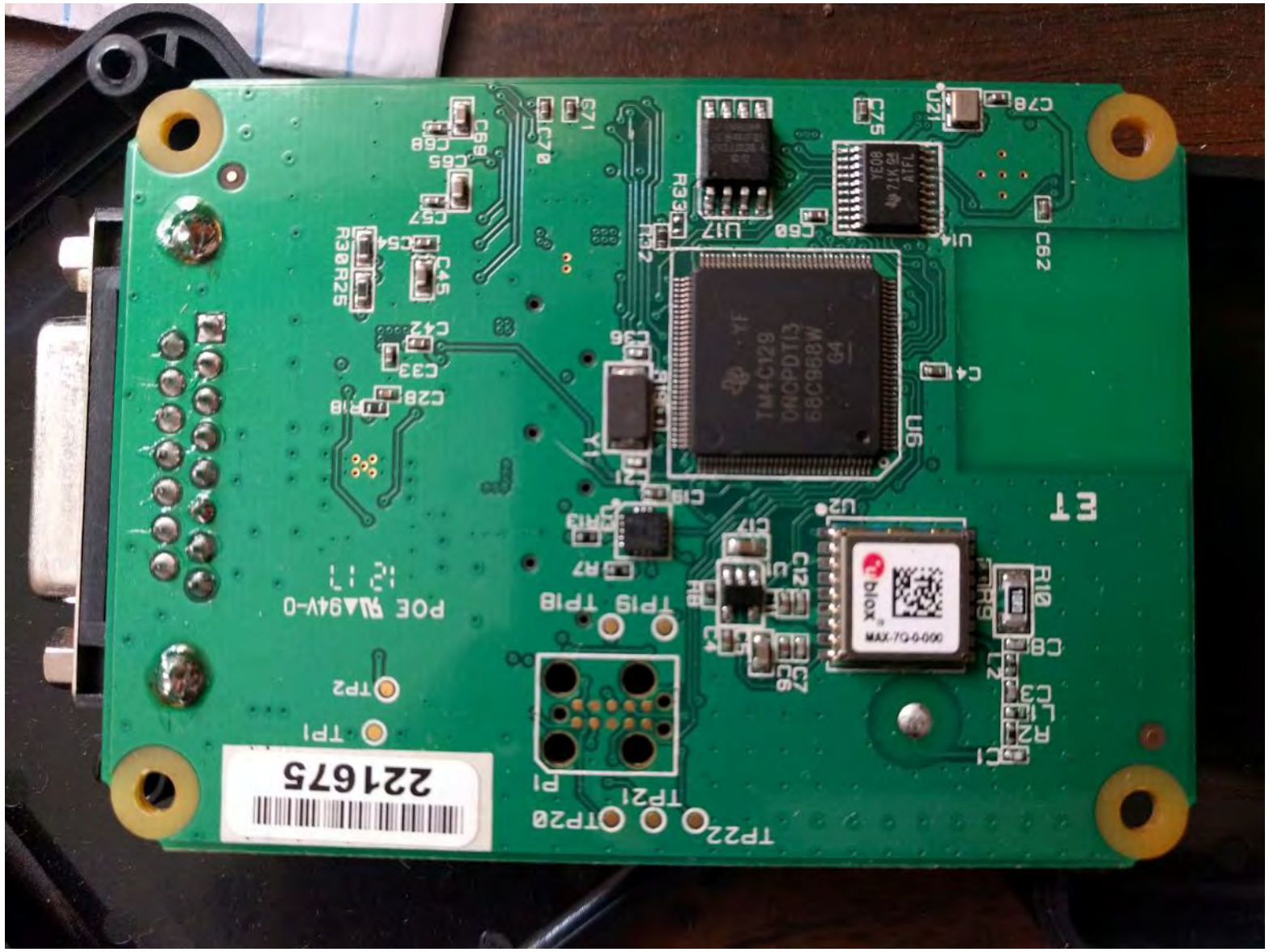
MCP2562T
SMT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MADE IN CANADA
Turbo v2.1
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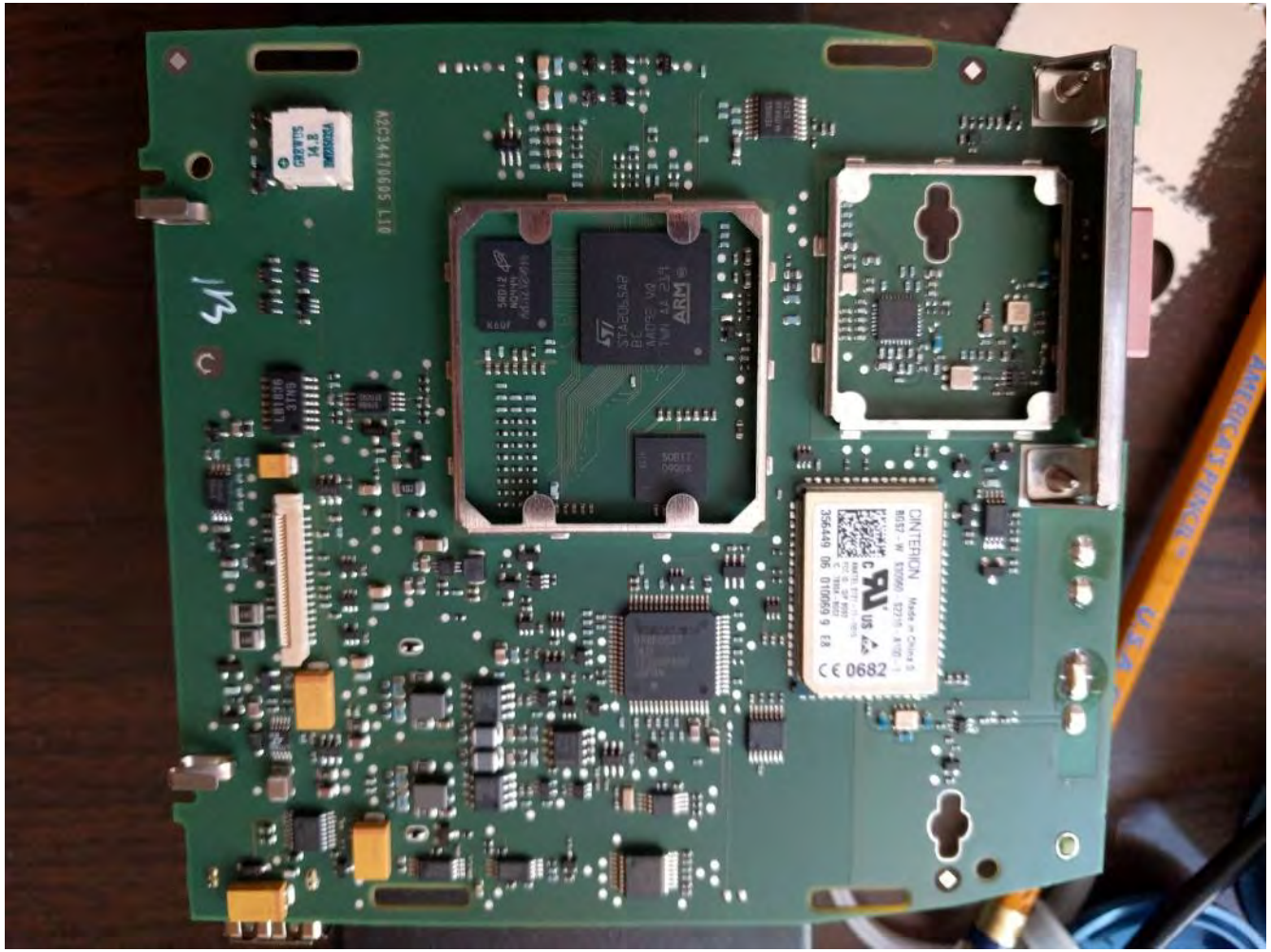
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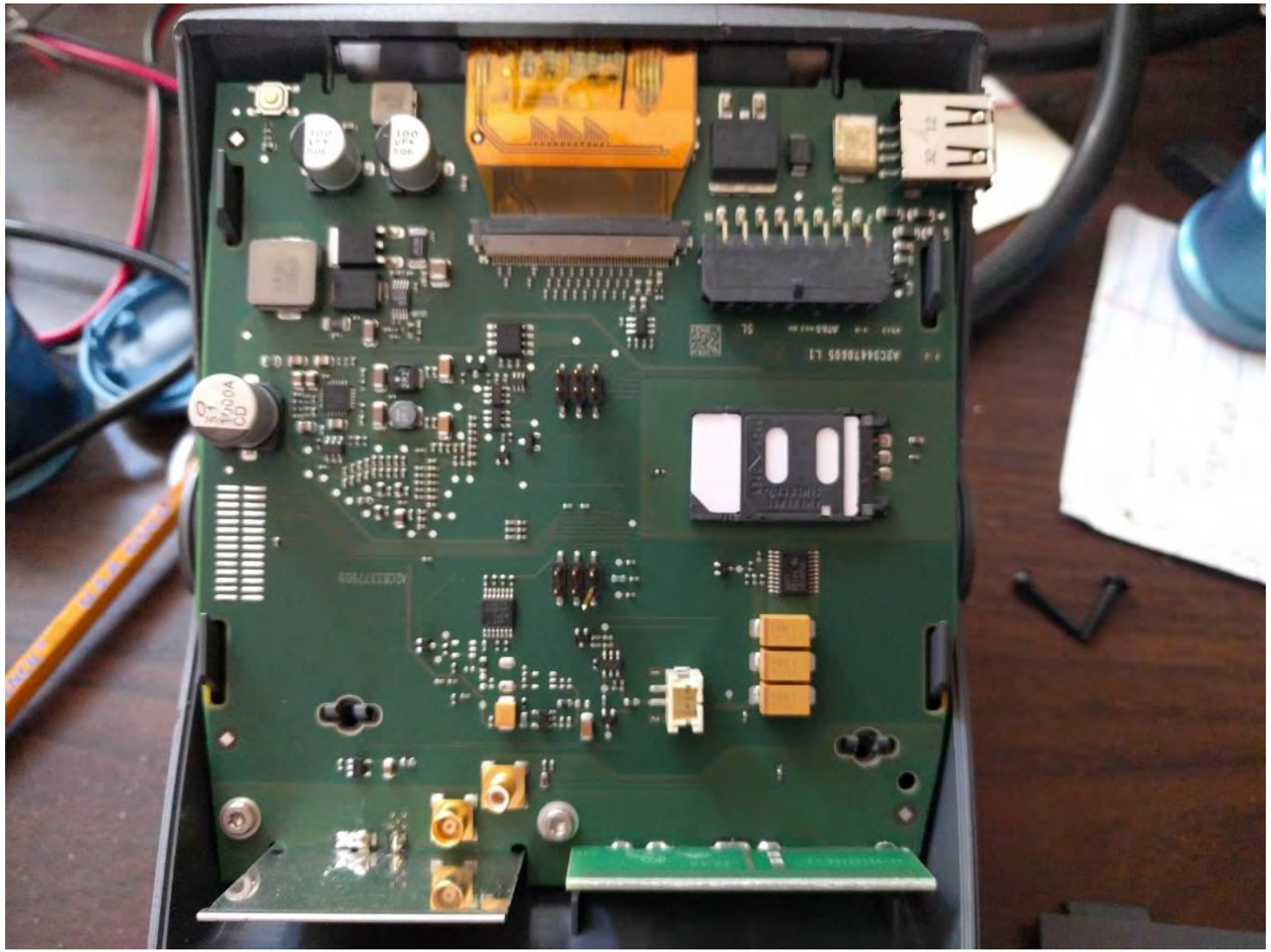

Software Analysis

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Software Analysis - Firmware

```
Terminal
Playing HOS Buffering (Long) Tone...
Playing HOS Buffer Near Full Tone...
Playing HOS Buffer Full Tone...
Playing Bluetooth Connect Tone...
Playing Bluetooth Disconnect Tone...
Invalid Command!
Buzzer Off
Buzzer Commands:
        z?      This screen
        zf      Set buzzer frequency (Hz)  (e.g: zf440)
        zh0     Play HOS Buffering Tone
        zh1     Play HOS Buffering (Long) Tone
        zh2     Play HOS Buffer Near Full Tone
        zh3     Play HOS Buffer Full Tone
        zh4     Play Bluetooth Connect Tone
        zh5     Play Bluetooth Disconnect Tone
        zp0     Buzzer off
        zp1     Buzzer on
J1939 Reset Off
J1939 Reset On
Invalid Command!
INDEX   PGN     SPN
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J1939 Bus Test:
J1939 Commands:
        c?      This screen
        cr0     J1939 Reset Line Off
        cr1     J1939 Reset Line On
        co      Output J1939 Data
        cf      Display J1939 Allowed PIDs
        ct      Perform J1939 Bus Test
 J1939: xQueueReceive() #0 failed
J1939 Length too short! len = %u
J1939: Failed to get byte %i of %i
Ayaq!H!I        x
 hci_receive_response() failed
parse_hci_m2_xet_event() failed
unexpected command 0x%02x
unexpected information_id 0x%02x
unexpected command_result 0x%02x
Total Tasks Running: %u
Total Run Time: %u
%s      %u      %u      %c      %u      %u              %u%%
%s      %u      %u      %c      %u      %u              <1%%
Clear record table.
Ticks == 0!
h@i 0&I hHa$H
 Record Data is empty!
record checksum mismatch! rec.crc8=%02X, crc=%02X
Record Data is now empty!
address = %u, crc8 = %02X, temp_rec.crc8 = %02X
data_read_record_table
pApp->record_table_head         = %u
pApp->record_table_sequence     = %u
pApp->record_data_start_address = %u
pApp->record_data_next_address  = %u
pApp->record_count              = %u
:
```

```
Terminal
FInitializing odometer at %d
Fwrite %x(%d)
Fverify failed @%x
/var/lib/jenkins/jobs/TurboFirmware_Release_14/workspace/src/firmware/turbo/common/flash.c
flash id failed
mfgId: %x deviceId: %x
Detected %s
Not detected
FInit complete
(addr % flashGetSectorSize()) == 0
_receiveEvent
_requestMailbox
Short packet
 pGTransport Error: %d for PID 0x%x
FFF too large: %d
FFF response failed
SF dropped
CF message dropped
CF overflow
CF seq: got %d expected %d
ppGgot fix
FUsing Simulated GPS Source
Simulated time set %u
Error: sim message bad sig
Error: sim message size (%d)
FTime set %d/%d/%d %d:%02d:%02d %d
NAV-PVT short
Resetting GPS Source to UART
Can't create HWI
../sensor.c
hpGaccel int0
No accel detected
FLIS3DH detected
LIS331DLH detected
I2C bus fault
FInit complete
FWrite failed: %d
FErase failed: %d
FEEPROM size
/var/lib/jenkins/jobs/TurboFirmware_Release_14/workspace/src/firmware/turbo/common/nvram.c
blockLength: %d; dataLength: %d
Offset: %d
No valid data
EEPROMInit failed
FNo valid data; erasing...
sizeof(NvData_t) % eepromBlockSize == 0
Init complete
Init complete
Reset Request Throttled
Reset Requested
Unhandled message 0x%x
Sending loopback %d
Message response failed: %d
Bad id 0x%x
Bad length
out of buffers
../j1708.c
:
```


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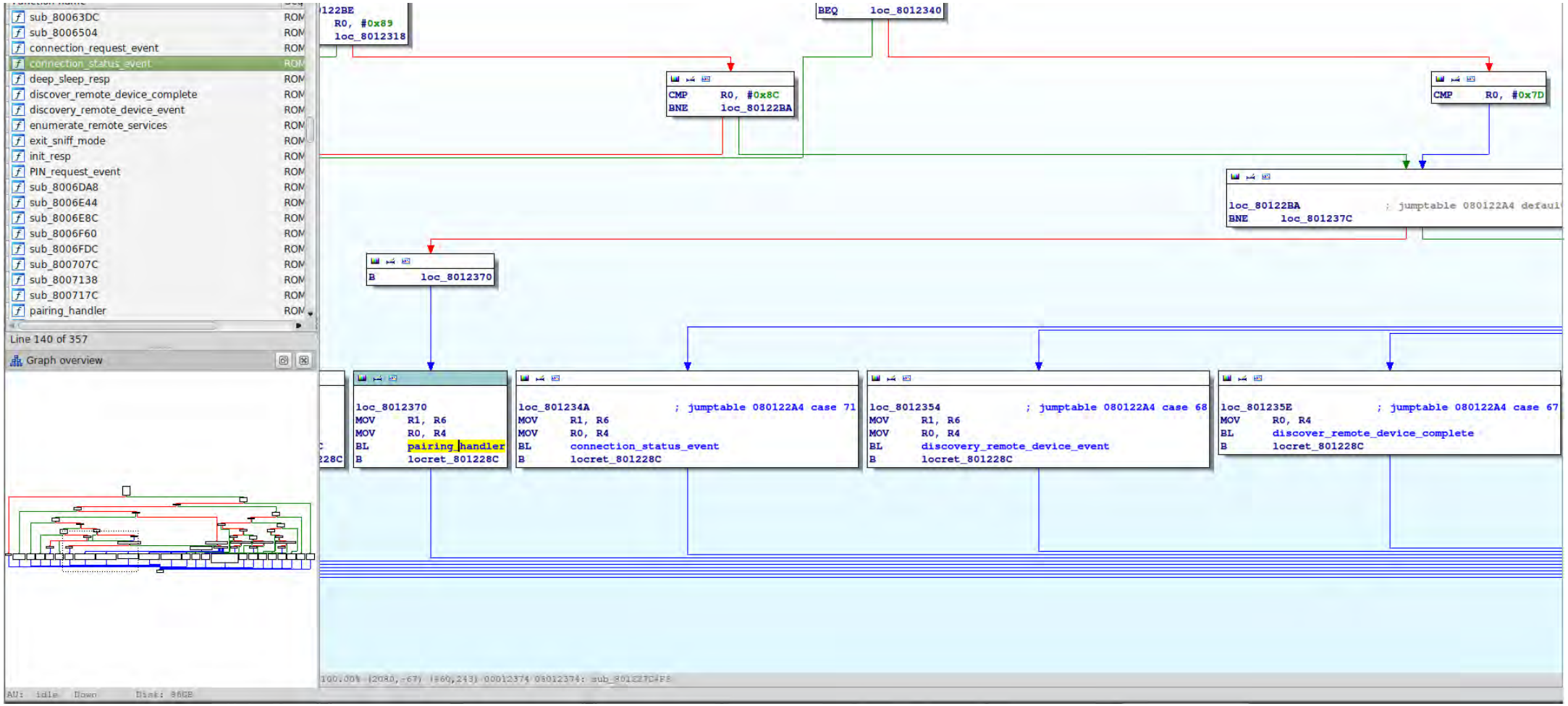
Software Analysis - RE



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Don’t Just Take My Word For It

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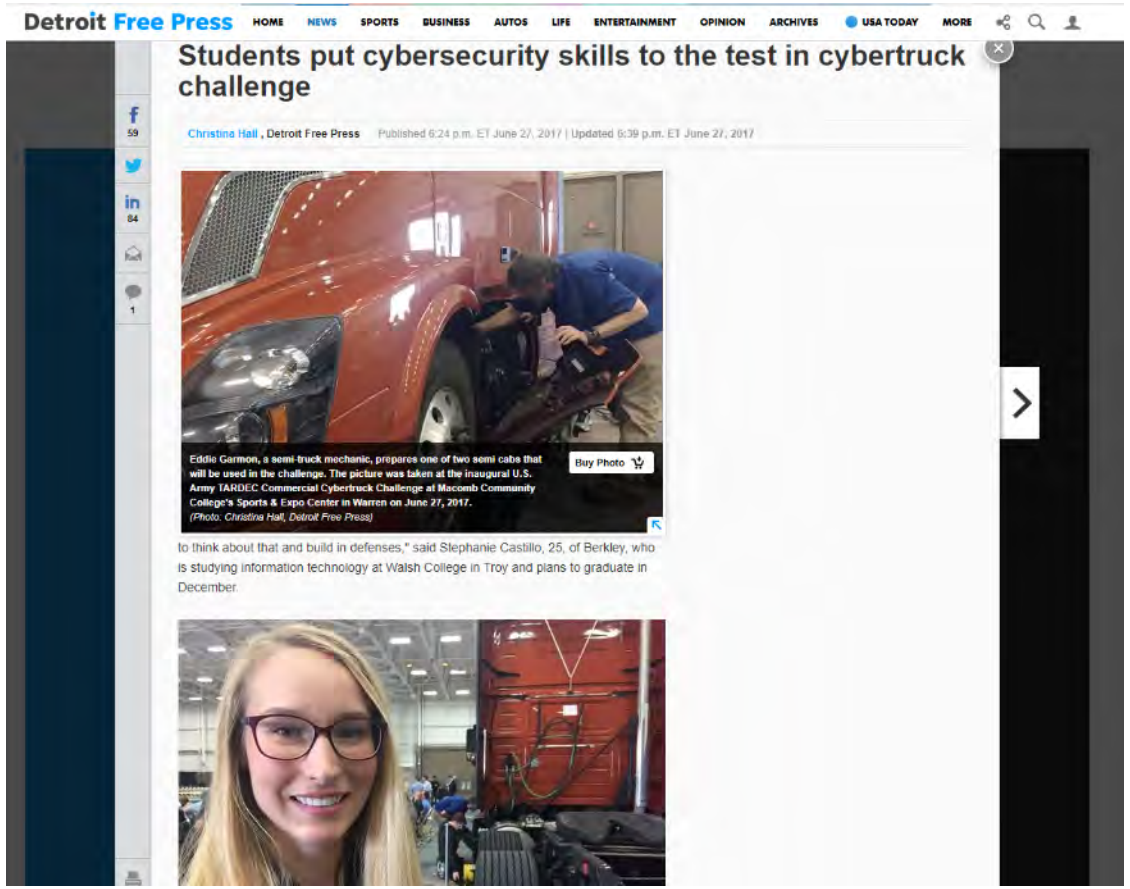
Cybertruck Challenge

- Students from multiple universities and community colleges
- 2 days class, 2 days hands-on
- No previous exposure or experience



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Students put cybersecurity skills to the test in cybertruck challenge

Christina Hall , Detroit Free Press Published 6:24 p.m. ET June 27, 2017 | Updated 6:39 p.m. ET June 27, 2017

Eddie Garmon, a semi-truck mechanic, prepares one of two semi cabs that will be used in the challenge. The picture was taken at the inaugural U.S. Army TARDEC Commercial Cybertruck Challenge at Macomb Community College's Sports & Expo Center in Warren on June 27, 2017. (Photo: Christina Hall, Detroit Free Press)

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to think about that and build in defenses," said Stephanie Castillo, 25, of Berkley, who is studying information technology at Walsh College in Troy and plans to graduate in December.

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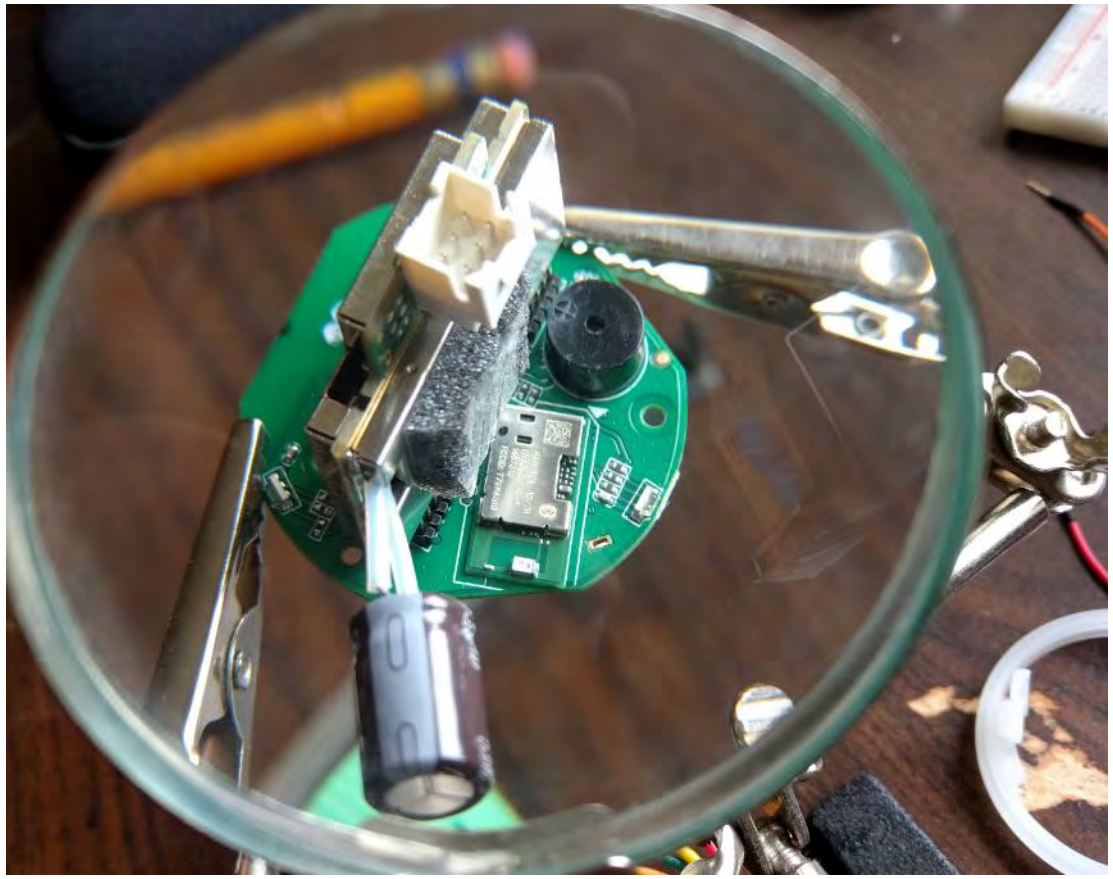
Student Results

- Extracted firmware over SWD
- Identified lack of encryption
- Basic Dynamic analysis with GDB

Student opinion of device security:

Low to non-existent



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Conclusions

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Security Overview

- Devices shipped with debug enabled
- Firmware easily accessible for analysis
  - Development strings present
  - Use of banned functions
- Lack of secureboot
- Lack of encryption for communications

Basically a general failure to follow cybersecurity best practices

Potential Impact

- Heavy Trucking is critical infrastructure
- What happens if the device is locally vulnerable?
- What happens if the device is remotely vulnerable?
- What about backend infrastructure?

Potential Impact

- Daniel Suarez – “The Daemon” is not that far out there
- A problem in Denver can affect trucks on the East coast
- ELDs are arguably easier to spoof than logbooks

Someday This Will Be Me

IOActive IOAsis at Black Hat Flashcard

- Electronic Logging Devices that replace driver logbooks are mandated by US Government
- These devices are heavily commoditized and fail to follow almost all cybersecurity best practices
- The impact to US critical infrastructure is real and remote connectivity without cybersecurity considerations is a threat

Heavy Trucks and Electronic Logging Devices: What Could Go Wrong?

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