

Trucking Industry Overview



Agenda

- Introduction
- Kinds of trucks
- Commercial Drivers Licenses
- Types of motor freight
- How does freight move
- Types of motor freight carriers
- Trucking statistics
- Telematics systems
- Equipment utilization
- Motor freight challenges
- Regulations
- How do you attack a trucking company?
- Truck hacking hints
- Q&A



Figure 1: Cyber truck logo (Cybertruckchallenge.org, 2021)

Meet the Speaker



Urban Jonson

- SVP Information Technology and Cybersecurity, SERJON
 - US FBI InfraGard Transportation Subject Matter Expert
 - Board of Directors, Cyber Truck Challenge
 - Program Committee, ESCAR USA
 - SAE VESS Committee Member
-
- Past experience
 - CTO at National Motor Freight Traffic Association (15 Years)
 - Program Manager of Commercial Transportation Security Research Program (8 years)
 - Various papers, talks and research on hacking trucks
 - Abusing and defending systems and asking awkward questions since 1980s

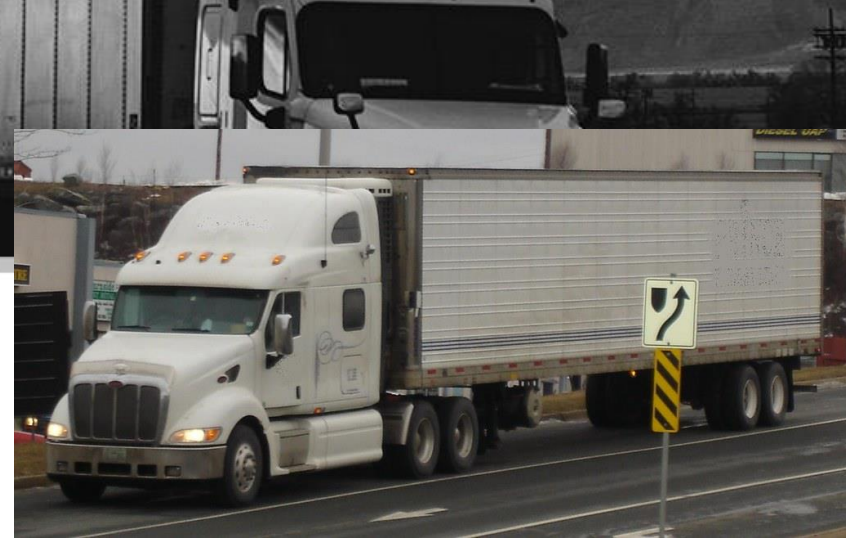


Motor Freight Transportation

- aka Trucking
- “If you bought it, a truck brought it”
- It is how food, goods, medicines, raw materials, and pretty much everything gets to where it needs to go
- For the most part no freight rails or water ports to the CVS, Wal*Mart and local grocery store or

Kinds of Trucks

- Tractor and Trailer
- Straight/Box Truck
- Flatbed
- Tankers
- Dry goods
- Specialized



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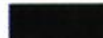


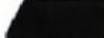



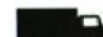






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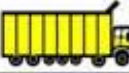























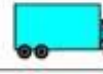

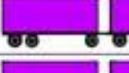





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Classes of Trucks

- A little confusing.... Done on axles or by gross vehicle weight (GVW)

 Minivan  Utility van  Multi-purpose  Full-size pickup	CLASS 1 6,000 lb & less	 Bucket  City delivery  Large walk-in	CLASS 5 16,001 to 19,500 lb
 Minivan  Utility van  Full-size pickup  Step van	CLASS 2 6,001 to 10,000 lb	 Beverage  Single-axle van  School bus  Rack	CLASS 6 19,501 to 26,000 lb
 Walk-in  Conventional van  City delivery	CLASS 3 10,001 to 14,000 lb	 Refuse  Furniture  City transit bus  Medium conventional	CLASS 7 26,001 to 33,000
 Conventional van  City delivery  Large walk-in	CLASS 4 14,001 to 16,000 lb	 Dump  Cement  Heavy conventional  COE sleeper	CLASS 8 33,001 lb & over

https://www.researchgate.net/figure/Truck-classifications-by-gross-vehicle-weight_fig2_323492305

Class 1 Motorcycles 	Class 7 Four or more axle, single unit   
Class 2 Passenger cars    	Class 8 Four or less axle, single trailer   
Class 3 Four tire, single unit   	Class 9 5-Axle tractor semitrailer  
Class 4 Buses   	Class 10 Six or more axle, single trailer  
Class 5 Two axle, six tire, single unit   	Class 11 Five or less axle, multi trailer 
Class 6 Three axle, single unit   	Class 12 Six axle, multi-trailer  
	Class 13 Seven or more axle, multi-trailer    

<https://www.fleetistics.com/fmcsa-vehicle-classifications/>



Commercial Drivers License (CDL)

- **Class A** – Tractor-trailers, tank vehicles, flatbeds, etc. but still requires endorsements
- **Class B** – Large buses, refuse trucks, box/straight trucks GVWR >26,000 but with towed vehicle <10,000 GVWR
- **Class C** – School buses, passenger vans, certain hazmat vehicles
- **Endorsements** – Air breaks, hazmat (H), double/triple (T), others
- **Restrictions** – Prohibits certain types of configurations, eg. O = 5th wheel connections, G = only daylight hours, E = manual transmission



Weight to Freight

- Tractor weighs in at around 17,000 lbs.
- Average tractor trailer combination weighs 32,000 pounds
- Freight weighs in at around 44,000 – 45,000 lbs.
- Total weight of tractor, trailer, and freight **max 80,000 lbs.**
- Range of Class 8 tractor, trailer and freight about **600 miles**
- Truckload carriers use long trailers up to 53 feet
- Carriers often use straight trucks or short 28-foot (pup) trailers for pickup and delivery
- Carriers operate trailer as singles, doubles and triples using Dollies/Jiffs

Dolly/Doubles



Image source: <https://www.odfl.com/>



Types of motor freight

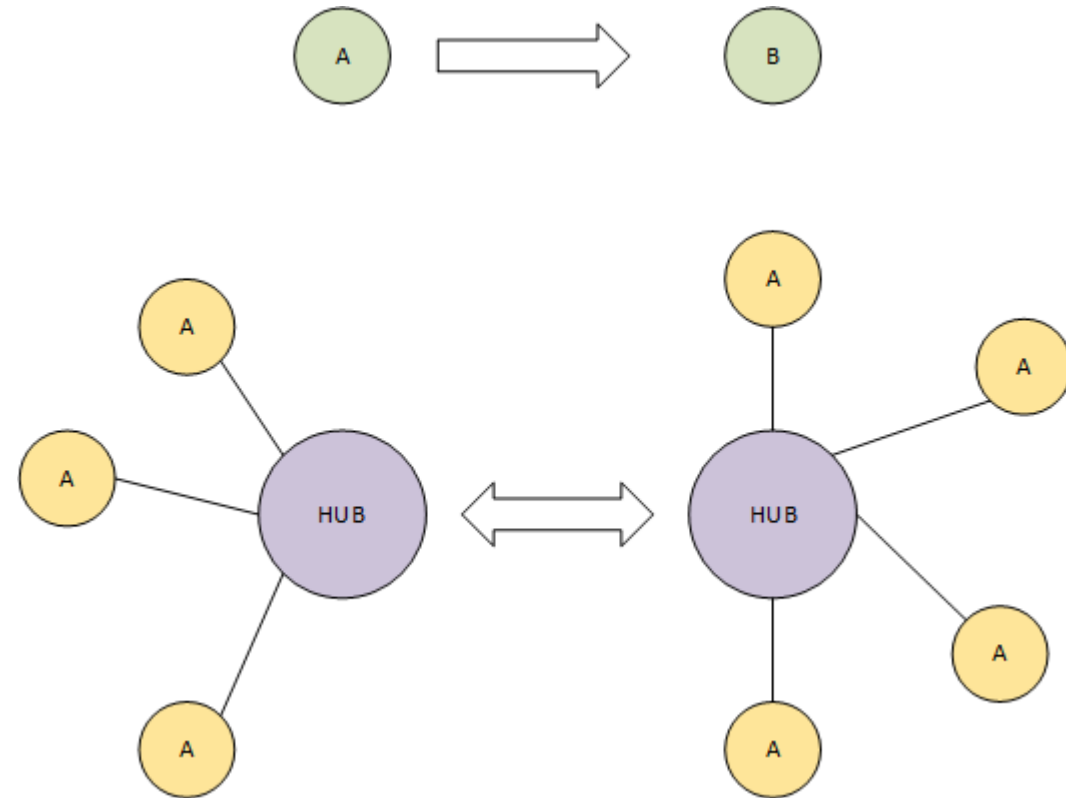
- Major **for-hire** segments
 - Truckload – A trailer full of one thing
 - Less-than-truckload – A trailer full of different things
 - Parcel/courier – Small package
 - Hazardous materials – Liquid or dry chemicals and other nasty things
 - Specialized hauls – Chemicals, bridge spans, building generators, etc.
 - Household goods – Moving companies
 - Intermodal – Shipping containers to/from rail or port
- **Not-for-hire**
 - Private Fleet – Large companies with trucks, e.g. Wal*Mart, Dominos, Pepsi etc.

NOTE: May companies operate multiple types of operations



How does freight move?

- Direct from point A to point B
 - Truck Load
 - Hazardous materials
 - Intermodal
 - Household
 - Specialized Hauls
- Hub and Spoke
 - LTL
 - Parcel
 - Household
- Interline





Truck Load (TL) Carriers

- Handle shipments ranging from 10,000 to 48,000 pounds
- Shipments originate from a single shipper and are destined to a single consignee
 - For example, paint from a factory to a distribution center
- Truckload carriers usually utilize tractor trailers and generally do not operate terminals
- Frequently do not have scheduled operations on regular routes
- Very similar patterns for hazardous materials and specialized hauls
- Includes some very interesting DOE and DOD shipping



Less Than Truck Load (LTL) Carriers

- LTL carriers, generally handle shipments that range from 150 to 10,000 pounds
- LTL carriers have freight from many different shippers on a vehicle at the same time
- LTL carriers operate terminals to consolidate and deconsolidate shipments and operate on regular routes and on schedules
- Freight is usually picked up in the afternoon by a driver with a straight truck or tractor trailer who is dispatched from a terminal and makes many stops before returning to the terminal



Less Than Truck Load (LTL), cont.

- The freight unloaded and sorted at the terminal usually at night
- Freight is then loaded on a line-haul trailer and driven overnight to another terminal where the freight is unloaded
 - Placed on another truck for delivery or
 - Consolidated and loaded on another truck for shipment to another terminal
- Freight destined for delivery usually is loaded on a straight truck or tractor trailer for local delivery in the morning
- Equipment used varies depending on freight volumes and equipment availability
- Similar operations for package and LTL household freight



Parcel Carriers

- Primarily handle small shipments of individual packages up to 150 pounds
- Operate terminal systems to consolidate and deconsolidate shipments using hub and spoke model
- Utilize small vehicles to pick-up and deliver packages
- Large vehicles (tractor trailers) for line-haul operations
- Examples include, FedEx Express, UPS, and Amazon



Hazardous Materials and Specialized Carriers

- Operate a wide variety of equipment with or without trailers
- Bulk liquids and gasses in tank trucks to transport chemicals, fuels and food-grade commodities, e.g. milk and cooking oils
- Carriers handles large quantity shipments of dry products, such as flour, salt, fertilizers, feeds and grains
- Utilize flatbed trailers to transport machinery and large vehicles or specialized trailers for automobiles
- Specialize in transporting oversize and overweight commodities on special trailers
- The most dangerous is Poison Inhalation Hazard (PIH) There is literally no one to haul it anymore, (e.g. Bromide)



Household Goods

- Household goods carriers transport the personal effects of homeowners
- Utilize straight trucks and/or tractor trailers to pick-up and deliver
- End points include homeowner's new location or storage warehouse
- Includes ABF u-Pack, ODFL Household Goods, etc.



Types/Sizes of Carriers

- Majority of the trucking companies (91.5%) is comprised of individual or small business owners (“six or less trucks”)
- \$732.3 billion in gross freight revenues (primary shipments only) from trucking, representing 80.4% of the nation’s freight bill in 2020
- 10.23 billion tons of freight (primary shipments only) transported by trucks in 2020, representing 72.5% of total domestic tonnage shipped
- 3.97 million Class 8 trucks (including tractors and straight trucks) in operation in 2020, up 1.5% from 2019



Freight Volumes/Economics

- Total freight tonnage will grow from an estimated 15.1 billion tons in 2021 to 19.3 billion tons in 2032—a 28% increase
- Trucking's share of the freight tonnage will slowly decline from 72.2% in 2021 to 71% in 2032—overall volumes will grow across all segments of the industry: truckload, less-than-truckload and private carrier. Truck tonnage should grow from 10.23 billion tons this year to 13.7 billion tons in 2023; and
- The total revenue derived from primary freight shipments in the U.S. will increase from an estimated \$1.083 trillion in 2021 to \$1.627 trillion in 2032



Rank 2022	Name	Revenue (000)	Employees	Tractors	Trailers
1	UPS Inc.	97,300,000	534,000	15,554	85,398
2	FedEx Corp.	91,683,000	577,000	37,488	136,947
3	XPO Logistics	12,800,000	42,000	7,900	25,800
4	J.B. Hunt Transport Services	12,168,000	34,978	18,617	39,994
5	TFI International	7,220,000	29,539	22,812	50,091
6	Landstar System	6,538,000	1,399	11,864	18,307
7	Knight-Swift Transportation Holdings	6,000,000	27,900	21,351	75,019
8	Schneider	5,600,000	16,050	11,300	36,700
9	Old Dominion Freight Line	5,256,000	24,372	10,403	41,220
10	Yellow Corp.	5,122,000	32,000	14,200	42,000
11	Ryder Supply Chain Solutions	4,612,000	41,900	70,700	43,500
12	Estes Express Lines	4,447,000	21,700	8,500	34,000
13	Hub Group	4,232,000	5,000	3,600	6,100
14	ArcBest	3,980,000	14,000	4,360	23,438
15	Penske Logistics	3,700,000	19,994	5,583	13,771

Source: [2022 Top 100 For-Hire Carriers | Transport Topics \(ttnews.com\)](https://www.ttnews.com/top100forhire)

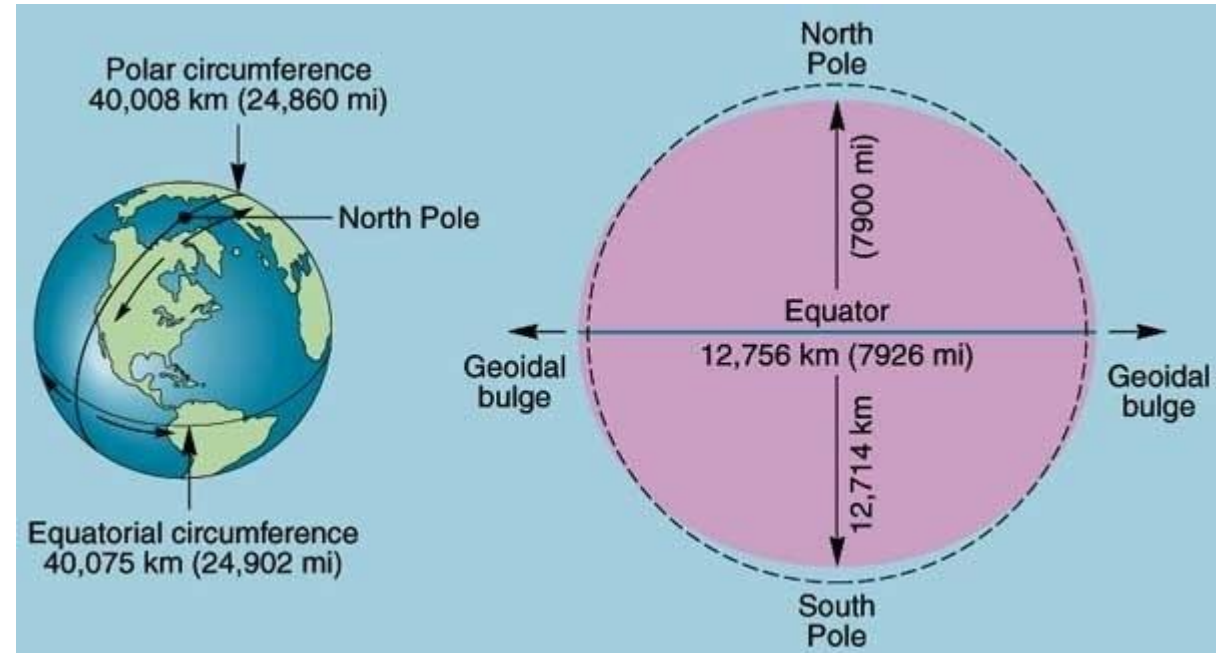


Telematics System Providers (TSPs)

- Trucking has been connected to telematics far longer than passenger cars
- Every truck has a connected device either through business processes or by regulation (ELDs)
- The devices are used for a number of things:
 - Log hours of service (HOS) required by regulations
 - Track vehicle and freight
 - Measure warehouse wait times
 - Driver/dispatch communication
 - Firmware updates (Cummins -> Geotab OTA firmware update)
 - Integrate into HR system for driver payroll
- Major providers include PeopleNet, Geotab, Omnitracs, Samsara, Cortex

Utilization of Equipment

- How many miles does a Sleeper truck run in a month? (23,600 miles)
- How would one person conceptualize that?
- How tightly do carriers monitor utilization?
- Most trucks are dual utilized
- What does that mean?
- How integrated is the cost model?
- If a driver stays at a customer's location an hour too long, carriers charge the customer delay pay and it impacts their pricing



Credit: This slide is courtesy of Sean Bumgarner, ODFL



Motor Freight Supply Chain Challenges

- In Service Equipment Lifespan Increases
- Docks run out of space
- Empty trailers are scarce
- Shippers ship too early and expect warehousing
- Each LTL step has a dependency on a predecessor
- Pandemic saw Increased velocity of purchased transportation but now we are seeing a systemic slow down

Credit: This slide is courtesy of Sean Bumgarner, ODFL



The Global Supply Chain

- Parts and chips shortage specifically causing shortage of trucks and trailers
- Trucks OEM build slots are completely allocated
- There is intense utilization, trucks are now traveling in excess of 1.25M miles
- The trucks are tired
- There are stress on everything from circuit boards to lug nuts



Credit: This slide is courtesy of Sean Bumgarner, ODFL



Regulations

- Federal Motor Carrier Safety Administration (FMCSA)
 - Regulates motor freight carriers
- National Highway Traffic Safety Administration (NHTSA)
 - Regulates vehicles
- California Air Resource Board (CARB)
 - Emissions and operational regulations
- US Environmental Protection Agency (EPA)
 - Emissions and equipment regulations



How do you attack a trucking company?

- Their backend systems (so far)
- Many companies use old, insecure platforms
- Old data management systems and they have not kept up with security, or system design let alone cyber security
- Many systems running on really old versions and not updated
- An unknown, but large number trucking companies have been attacked with ransomware in the past few years (reporting is not mandatory so we don't know true count but it's 50+ in the last 12 months)



Predictions

- Someone's going to go after the trucks
- Someone will figure out how to mass disable fleet vehicles
- They're going to be successful *(Besides me)*
- Diagnostics will not detect it until its too late
- Government and Trucking industry will panic
- This is not fear mongering, this is reality



Truck Juicy Bits (hints)

Where you might want to consider doing some research:

- Tractor Brake controllers
- Emissions related functions (e.g. DEF fluid levels)
- ADAS control messages
- CAN BUS (J1939) proprietary PGNs
- CAN BUS (J1939) oldest PGNs
- Infotainment systems
- Anything that looks like a USB port
- Check with vehicle boss about predefined challenges (capture the flag)

The stakes are high ...



Image source: <https://www.maxpixel.net/static/photo/1x/Pudong-City-Shanghai-Apocalypse-City-Apocalypse-5808557.jpg>



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Thank You

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