Internet of Things

& Connected and Highly Automated Systems

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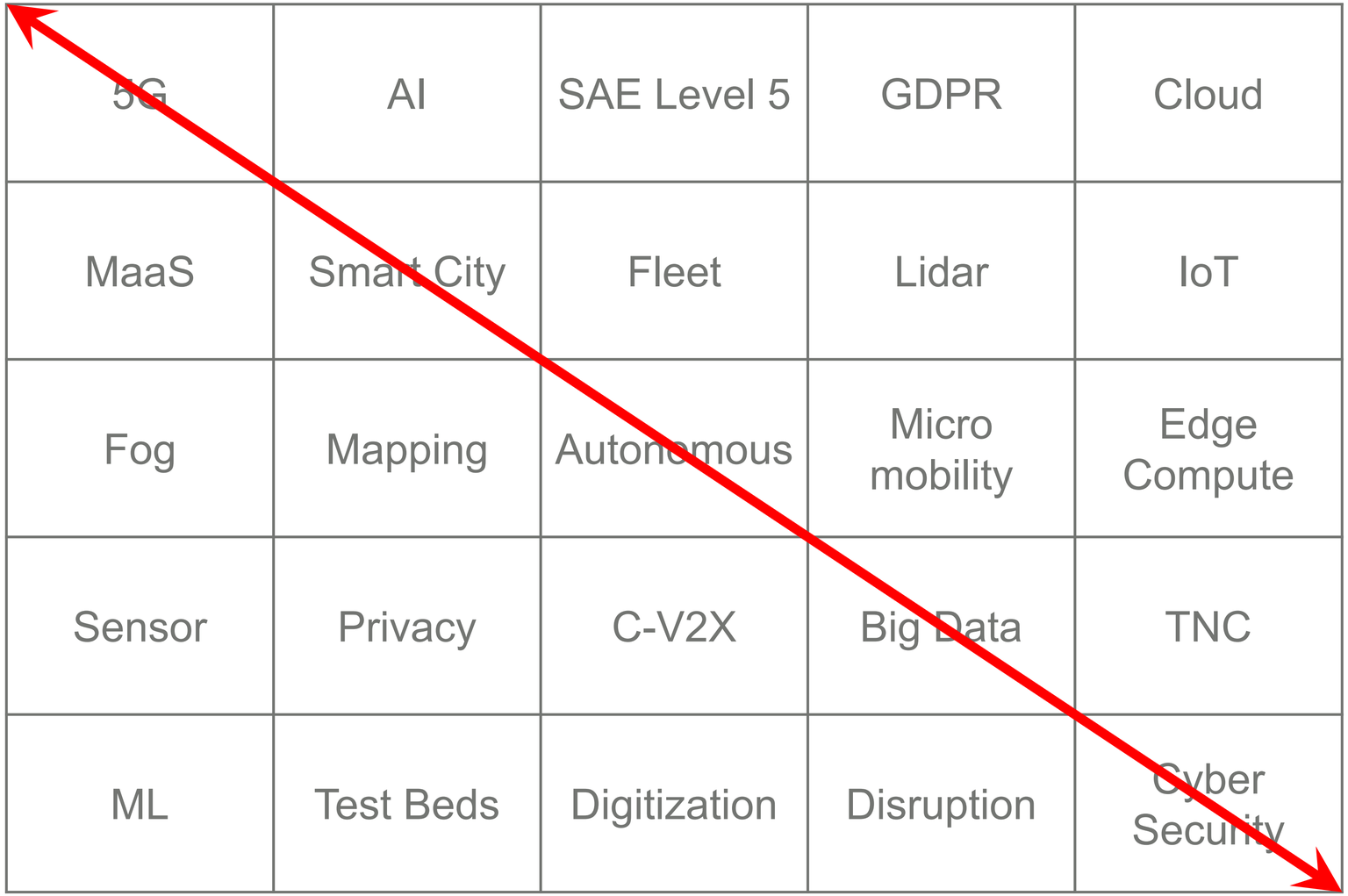
ECONOLITE

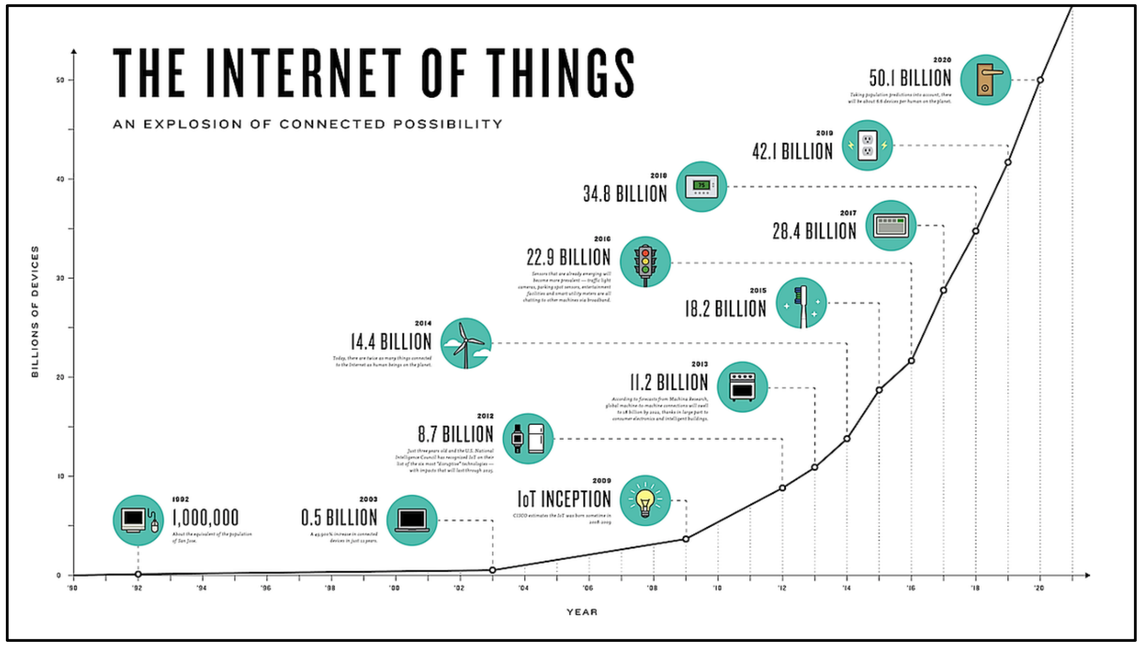
Buzz Word Bingo

5G	AI	SAE Level 5	GDPR	Cloud
MaaS	Smart City	Fleet	Lidar	IoT
Fog	Mapping	Autonomous	Micro mobility	Edge Compute
Sensor	Privacy	C-V2X	Big Data	TNC
ML	Test Beds	Digitization	Disruption	Cyber Security



History

- Idea had been around since at least the 1980s CMU/Coke Machine
- Likely named in 1999
- Started with a single technology concept RFID
- Assumed volume and lower cost point of the devices would lead to ability to connected everything to a network through a tag
- Began to gain traction in early 2000's due to the visibility of data on 3G networks
- Really began to take off in 2008 as 4G networks evolved
- Ericson and others forecasted 50 billion devices networked by 2020
- Began to separate Consumer IoT from Industrial IoT in 2011
- Verticalization and outcome-based Industrial IoT in 2012 created the ability to monetize and scale

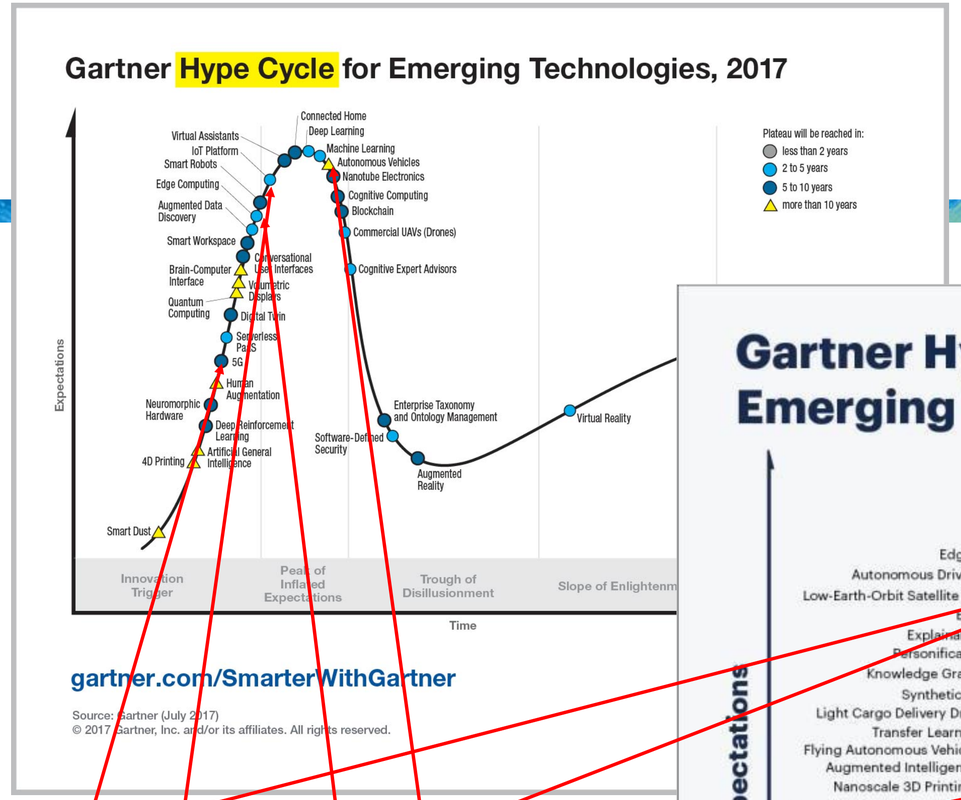


https://www.scoopnest.com/user/WarrenWhitlock/658491392671387648-staggering-50-billion-devices-by-2020-internet-of-things-permeates-our-lives-ibminsight-iot-cloud-via-jimharris

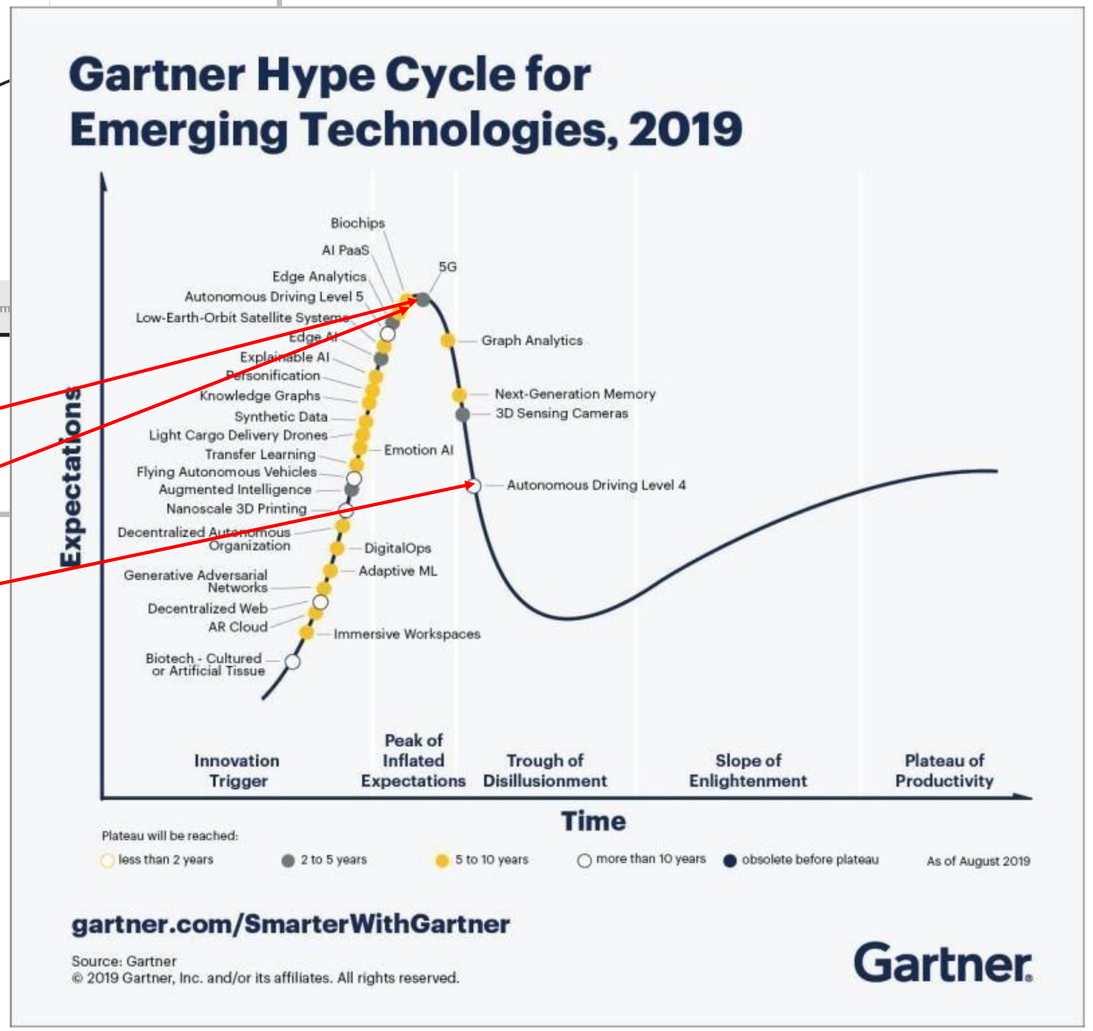
Evolution

The definition of the Internet of things continues to evolve due to introduction of and convergence in multiple technologies:

- **Blockchain**
- **End to End Security**
- **Edge Compute**
- **Analytics**
- **Machine Learning**
- **New Sensor Technologies**
- **Embedded Systems**
- **Battery Technologies**
- **Wireless Networks**
- **Automation**
- **Multi & Hybrid Cloud Services**
- **Data Brokerage, Exchange, Catalogs Digital Rights**
- **Digital Twins**
- **3D Mapping and Location Services**



- 5G
- Edge Computing to Edge Analytics
- IoT Platforms
- Autonomous Vehicles to Level 4 and Level 5



Faster Rollout of Self-Driving Cars Would Save Lives, Study Says

RAND analysis suggests that waiting for perfect technology will result in thousands of needless fatalities

By Jeff Plungis
November 07, 2017

A new study says that waiting too long to roll out self-driving cars will lead to thousands of preventable highway fatalities.

The study by the RAND Corporation is sure to stir an already heated debate among automakers, regulators, and safety advocates about how safe self-driving cars should be before they're widely allowed to roam public roads. RAND says that introducing the technology when it's only a little better than human drivers will save the most lives.

Table 1: Fatalities and Fatality Rate by Quarter, First Half, and the Percentage Change From the Corresponding Quarter or First Half in the Previous Year

Quarter	1st Quarter (Jan–Mar)	2nd Quarter (Apr–Jun)	3rd Quarter (Jul–Sep)	4th Quarter (Oct–Dec)	Total (Full Year)	1st Half (Jan–Jun)
Fatalities and Percentage Change in Fatalities for the Corresponding Quarter From the Prior Year						
2007	9,354	10,611	11,056	10,238	41,259	19,965
2008	8,459 [-9.6%]	9,435 [-11.1%]	9,947 [-10.0%]	9,582 [-6.4%]	37,423 [-9.3%]	17,894 [-10.4%]
2009	7,552 [-10.7%]	8,975 [-4.9%]	9,104 [-8.5%]	8,252 [-13.9%]	33,883 [-9.5%]	16,527 [-7.6%]
2010	6,755 [-10.6%]	8,522 [-5.0%]	9,226 [+1.3%]	8,496 [+3.0%]	32,999 [-2.6%]	15,277 [-7.6%]
2011	6,726 [-0.4%]	8,227 [-3.5%]	8,984 [-2.6%]	8,542 [+0.5%]	32,479 [-1.6%]	14,953 [-2.1%]
2012	7,521 [+11.8%]	8,612 [+4.7%]	9,171 [+2.1%]	8,478 [-0.7%]	33,782 [+4.0%]	16,133 [+7.9%]
2013	7,166 [-4.7%]	8,207 [-4.7%]	9,024 [-1.6%]	8,496 [+0.2%]	32,893 [-2.6%]	15,373 [-4.7%]
2014	6,856 [-4.3%]	8,179 [-0.3%]	8,799 [-2.5%]	8,910 [+4.9%]	32,744 [-0.5%]	15,035 [-2.2%]
2015	7,370 [+7.5%]	8,823 [+7.9%]	9,805 [+11.4%]	9,486 [+6.5%]	35,484 [+8.4%]	16,193 [+7.7%]
2016	8,154 [+10.6%]	9,563 [+8.4%]	10,078 [+2.8%]	10,011 [+5.5%]	37,806 [+6.5%]	17,717 [+9.4%]
2017	8,272 [+1.4%]	9,392 [-1.8%]	9,999 [-0.8%]	9,470 [-5.4%]	37,133 [-1.8%]	17,664 [-0.3%]
2018†	*8,070 [-2.4%]*	*9,050 [-3.6%]*	—	—	—	*17,120 [-3.1%]*
Fatality Rate per 100 Million Vehicle Miles Traveled (VMT)						
2007	1.31	1.35	1.41	1.37	1.36	1.33
2008	1.22	1.25	1.33	1.32	1.26	1.23
2009	1.09	1.16	1.17	1.12	1.15	1.13
2010	0.98	1.09	1.18	1.14	1.11	1.04

Police-Reported Crashes, by Crash S

pe	2014	2015	Change
s	30,056	32,166	+2,11
ashes	6,034,000	6,264,000	+230,00
hes*	1,648,000	1,715,000	+67,00
amage Only	4,387,000	4,548,000	+161,00
s	6,064,000	6,296,000	+232,00

2014 Final File, 2015 ARF; NASS GES 2014, 2015
tistically significant.

Key areas to consider-Safety

Key areas to consider- Economic Impact

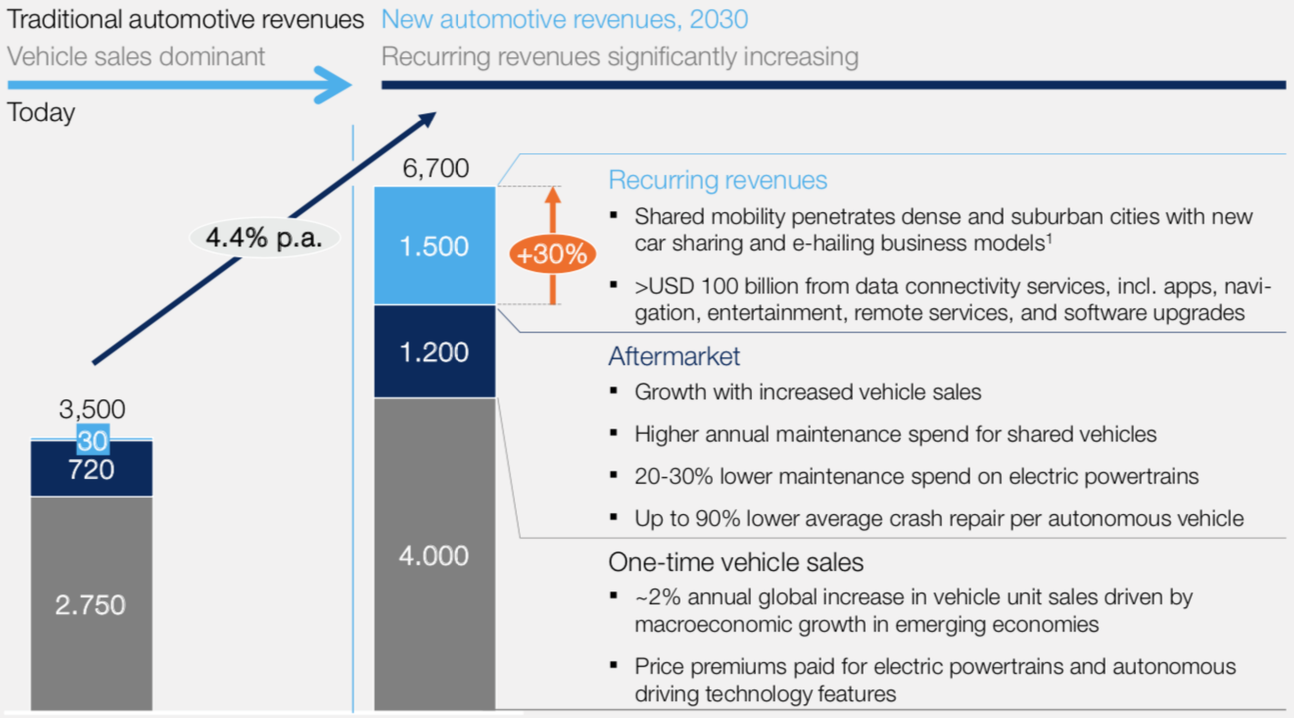
$2T-$6T

Exhibit 1

The automotive revenue pool will grow and diversify with new services potentially becoming a ~USD 1.5 trillion market in 2030

HIGH-DISRUPTION SCENARIO

USD billions



1 Does not include traditional taxi and rentals

SOURCE: McKinsey

How the IoT Industry Sees Our Market

- Connected Vehicle
- Automated Vehicle
- Intelligent Transportation Systems
- Smart City Urban Mobility
- Transportation Network Companies
- Micro Mobility
- Mobility as a Service

Today

- Copper
- Fiber
- 3GPP
- 802.xx
- Lora
- Bluetooth

Connect

- End to End
- Standardized
- Upgraded Edge Devices
- Physical

Secure

- Proprietary to Standardize
- Legacy Devices
- Analog to IP
- Business processes
- Valuation of solution

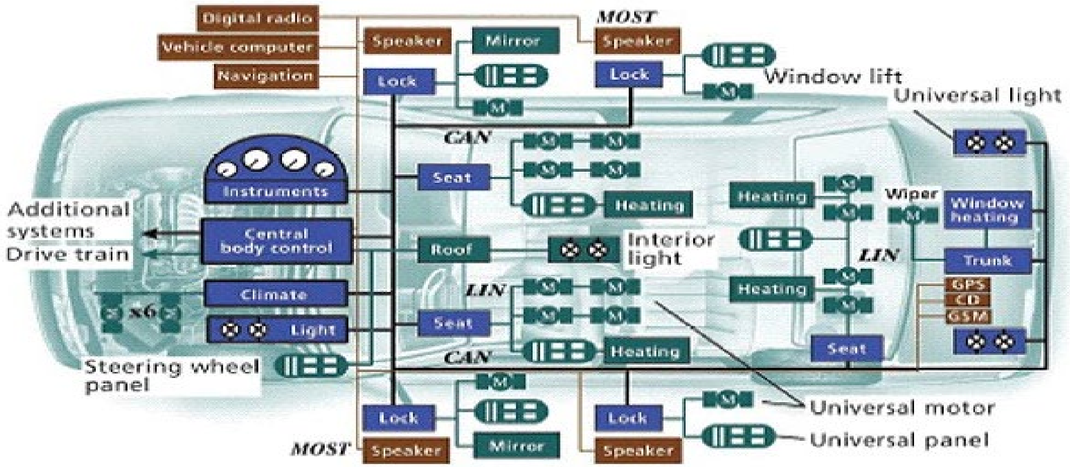
Digitize

- Building Automation
- Home Automation
- Automated Vehicles
- Automated Farming
- Pit to Port Mining
- UAS/Drones

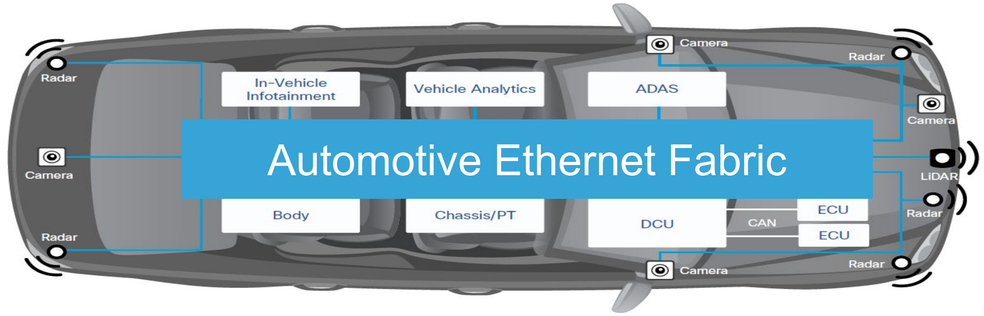
Automate

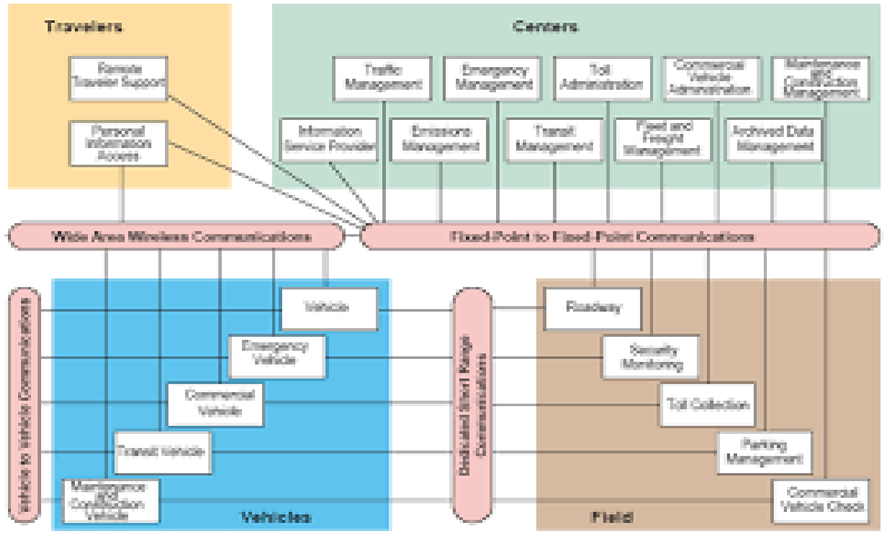
What must change ?

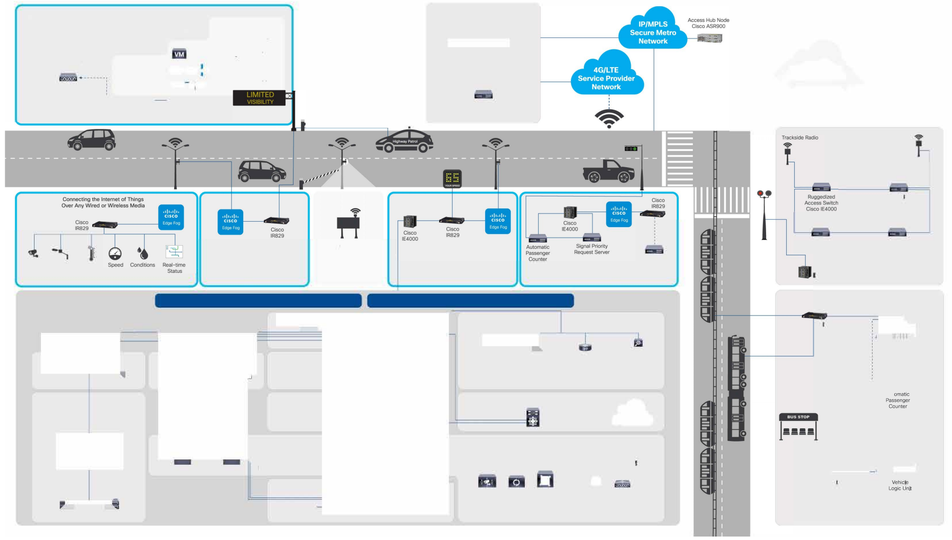
From Manufacturing Driven-Analogue



To Consumer Driven- Digital, Converged







OEM's

Top 15 Global OEM's 2016 per Wiki

Rank	Group	Country	Vehicles
1	Volkswagen Group	Germany	10,405,092 [40]
2	Toyota	Japan	10,213,486
3	Hyundai	South Korea	7,889,538
4	General Motors	United States	7,793,066
5	Ford	United States	6,429,485
6	Nissan	Japan	5,556,241
7	Honda	Japan	4,999,266
8	Fiat Chrysler Automobiles	Italy / United States	4,681,457
9	Renault	France	3,373,278
10	PSA	France	3,152,787
11	Suzuki	Japan	2,945,295
12	SAIC	China	2,566,793
13	Daimler	Germany	2,526,450
14	BMW	Germany	2,359,756
15	Changan	China	1,715,871

Top 10 Global OEM's 2017 per Focus 2 Move

Worldwide Car Sales 2013 to 2017

Car sales in the major car markets of the world were as follows in recent years:

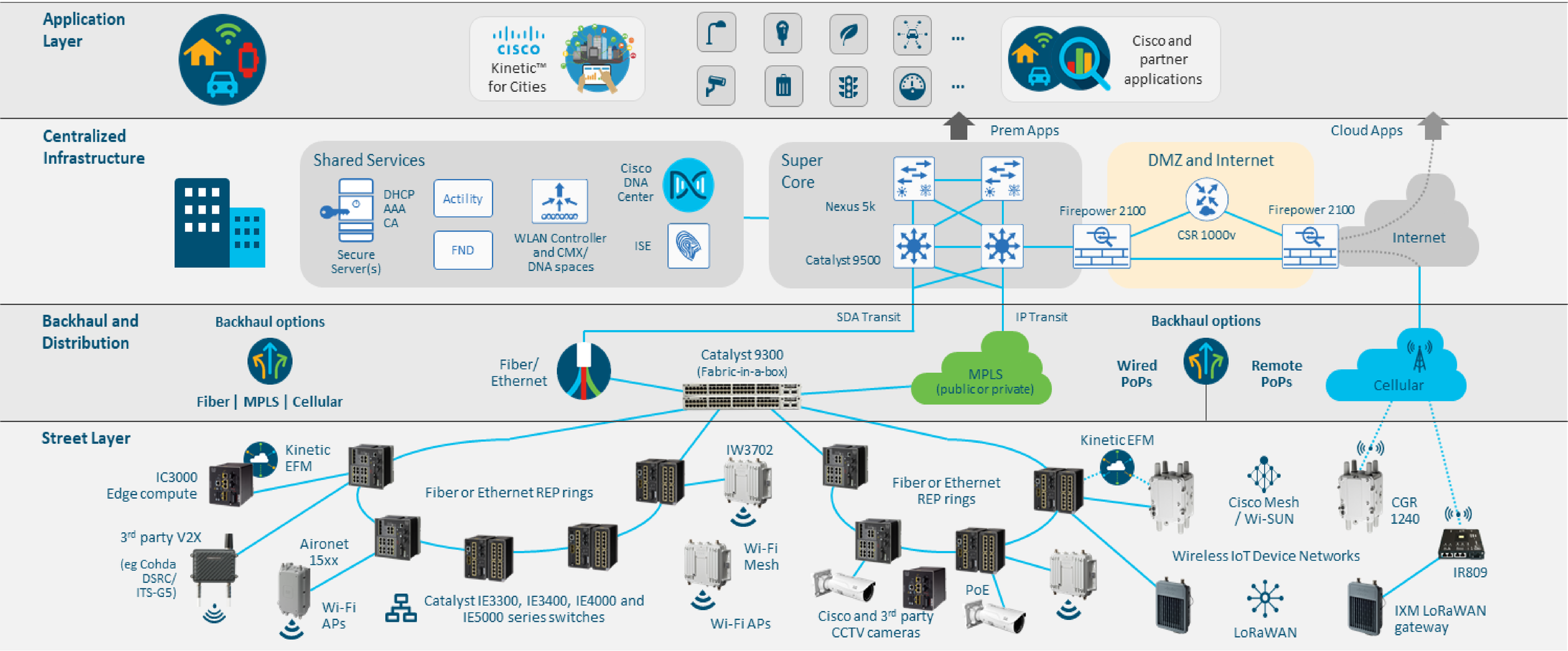
Region	2017	2016	2015	2014	2013
Europe (EU+EFTA)	15,631,700	15,131,700	14,201,900	13,006,500	12,308,200
Russia*	1,595,700	1,425,800	1,601,200	2,491,400	2,777,400
USA*	17,134,700	17,465,000	17,386,300	16,435,300	15,531,600
Japan	4,386,400	4,146,500	4,215,900	4,699,600	4,562,300
Brazil*	2,176,000	1,988,600	2,480,500	3,333,400	3,579,900
India	3,229,100	2,966,600	2,772,700	2,570,500	2,554,000
China	24,171,400	23,693,400	20,047,200	18,368,900	16,303,700
*Light vehicles					
Combined:	68,325,000	66,817,600	62,705,700	60,905,600	57,617,100
Source: VDA					

Strong Car Sales in China in 2017

China remained by far the world's largest single-country car market in 2017. Car sales in China increased by 2% to 24,171,400 cars – German luxury carmakers generally increased sales by higher margins.

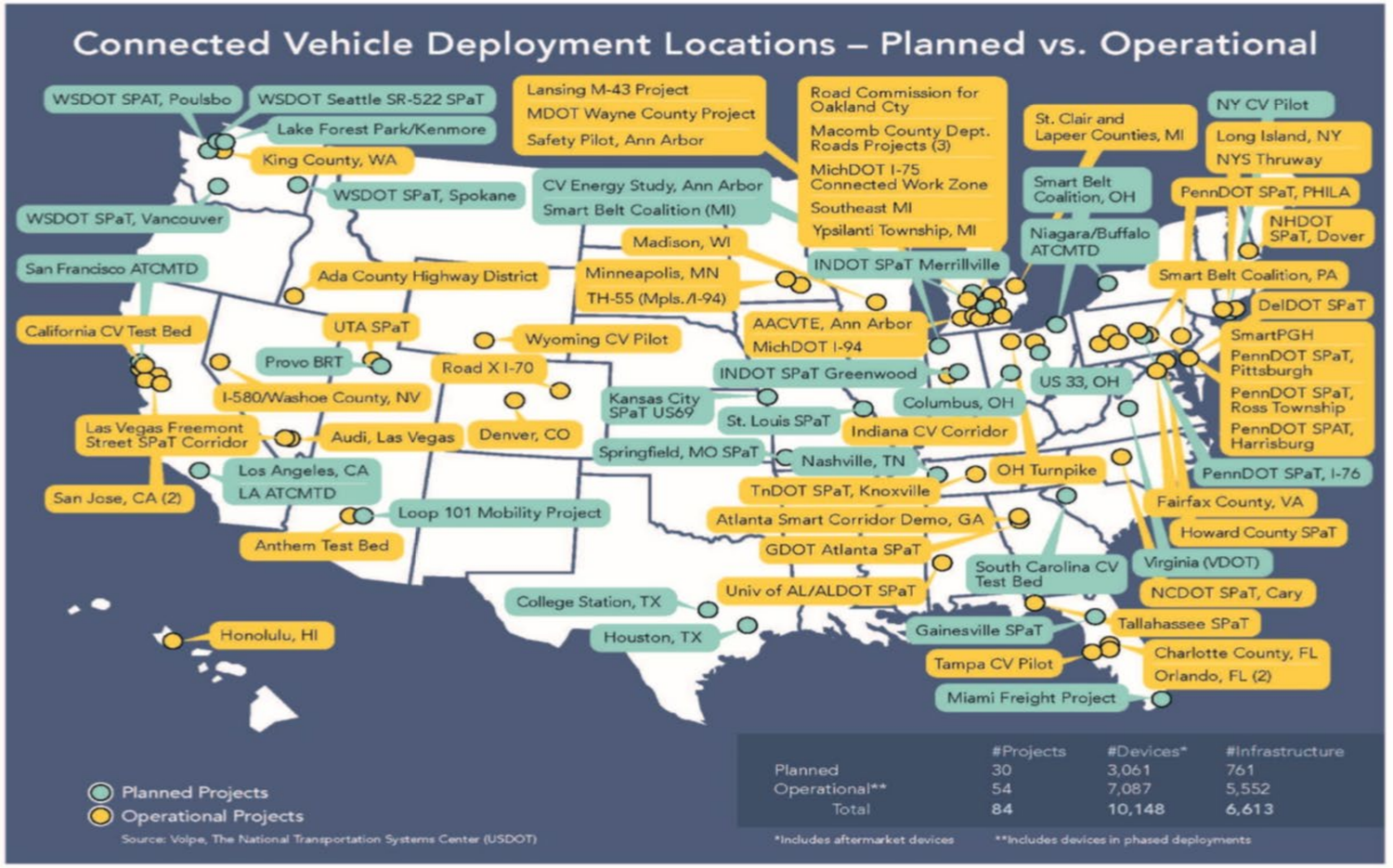
Ultimately the top 10 OEM's and Top 3 Governments for OEM sales will likely drive the decision on which wireless technologies are used for V2X vital safety

Connected Communities Infrastructure
High-level architecture



AASHTO SPaT and Connected Fleet Challenge

- Connected vehicles are being tested nationwide
- USDOT supports "Connected Automation" for self-driving cars
- New Security Credential Management System is operational
- USDOT proves connected vehicles are interoperable
- Free connected vehicle data is available to the public



Betamax versus VHS Does it really matter?

Film

1893

BetaMax/VHS

1975

1976

Digital Media Rights
1983

DVD

1995

DVR

1999

Blu Ray

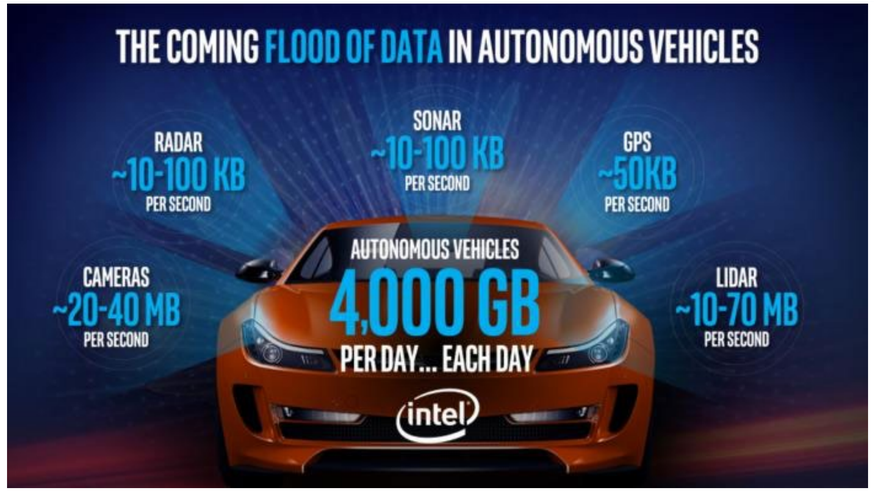
2002

hulu

Streaming

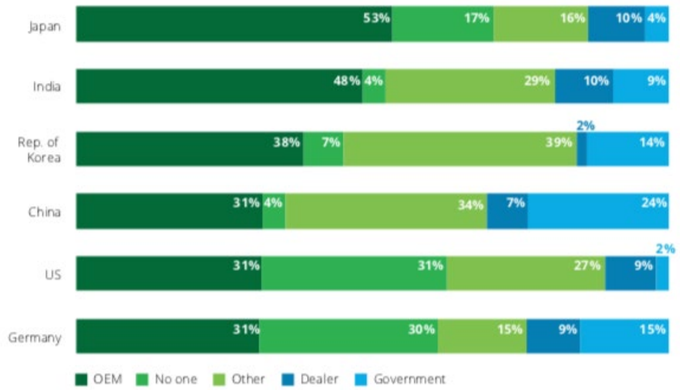
2008

Explosion of data-driven software development



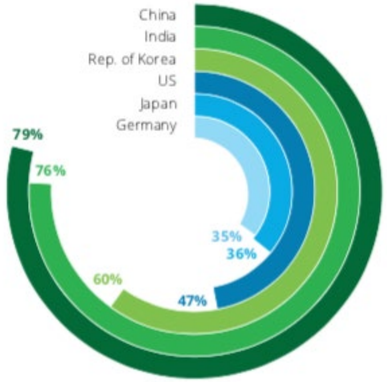
Consumer concern also extends to who would manage the data being generated and shared by the vehicle. Some people would choose the OEM, but a lot of people would choose anybody else.

Consumer preference regarding the type of company they would most trust to manage the data being generated and shared by a connected car



When it comes to vehicle connectivity, consumer opinion is split. Consumers in China are embracing the idea at over twice the rate compared to Japan and Germany.

Percentage of consumers who feel that increased vehicle connectivity will be beneficial



https://www2.deloitte.com/us/en/pages/manufacturing/articles/automotive-trends-millennials-consumer-study.html

White paper
Public

cisco

The Driven Hour

It's time to get more realistic about Connected Cars and the volume of data that they will generate.

Joel Obstfeld
Distinguished Engineer, Chief Technology & Architecture Office, Cisco

Mark Grayson
Distinguished Engineer, Chief Technology & Architecture Office, Cisco

Executive summary

Connected Vehicles are considered to be one of the major drivers for investment in cellular communications technologies with forecasts projecting every new vehicle produced being 'connected' by 2025[1].

What does this mean with respect to the impact on communications networks? What are the applications driving the growth in data and what data volumes will network operators be expected to transport?

The paper examines today's Connected Cars, to consider the range of applications being used to provide information to the vehicle manufacturers, those designed for the consumer and the data volumes vehicles will generate and consume. The paper looks forward to the next generation of vehicles, past the hype of '4TB per day' to understand what future applications may look like and what data volumes will these produce.

As this paper illustrates, Connected Vehicles will generate significant volumes of data but:

a) most of the data will be consumed within the vehicle

b) only a 'valuable' subset of the data will be transmitted

c) the commuter vehicle duty-cycle data volume will be roughly ~8GB, not the 4TB figure initially suggested.

Transferring data comes at a cost - as the number of Connected Vehicles and data volumes increase, network operators and vehicle manufacturers will need to make certain considerations to support vehicles of a global scale. However, this is only one element of the data transport and processing pipeline between the vehicle and the vehicle manufacturer's data centres. The cost of data needs to be considered in a broader, more holistic context, since the cost of cloud-based computing solutions includes not just the compute but storage and data transmission from the cloud.

[1] https://www.gsma.com/iot/wp-content/uploads/2013/06/cl_ma_forecast_06_13.pdf

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https://blogs.cisco.com/sp/connected-car-the-driven-hour

Key Takeaways

- ✓ The concept of IoT is 20 years old in 2019
- ✓ IoT has evolved and new technologies have come along
- ✓ IoT will likely be vertically driven for most of the next decade
- ✓ The tech industry sees our industry as one of the top 3 targets for IoT
- ✓ There are large opportunities for the industry
- ✓ There is also a large threat from inaction
- ✓ You need to build a plan for how to participate

Call To action

- Get involved
- Get educated
- Join the CAT Coalition
  - https://transportationops.org/CATCoalition
- Join the SPaT Challenge and Fleet Challenge
  - https://transportationops.org/connected-fleet-challenge
- AASHTO Webinar available on-line → more upcoming
  - Webinar October 03, 2019 from 2:00 pm – 3:30 pm EDT
- Remember why you are doing this
- Think of Technology as Infrastructure
- Plan, Budget, Design, Implement, Operate

References

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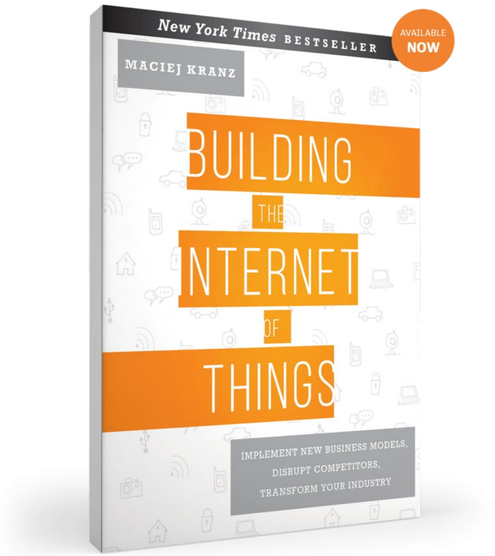
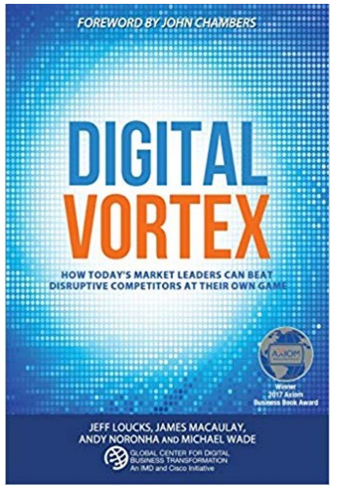
- https://en.wikipedia.org/wiki/Internet_of_things





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Thank You