

Replacing physical infrastructure with digital infrastructure

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Smart city: Short term opportunities



Hugh Bradlow - 2017 WA Local Government Convention

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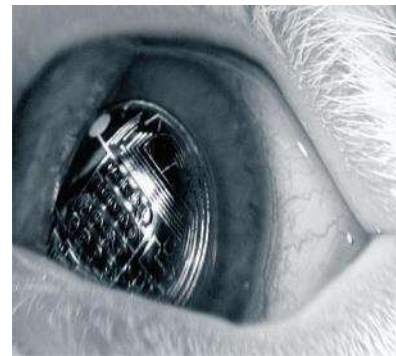
Emerging Technology will trigger
a new and different wave of
change



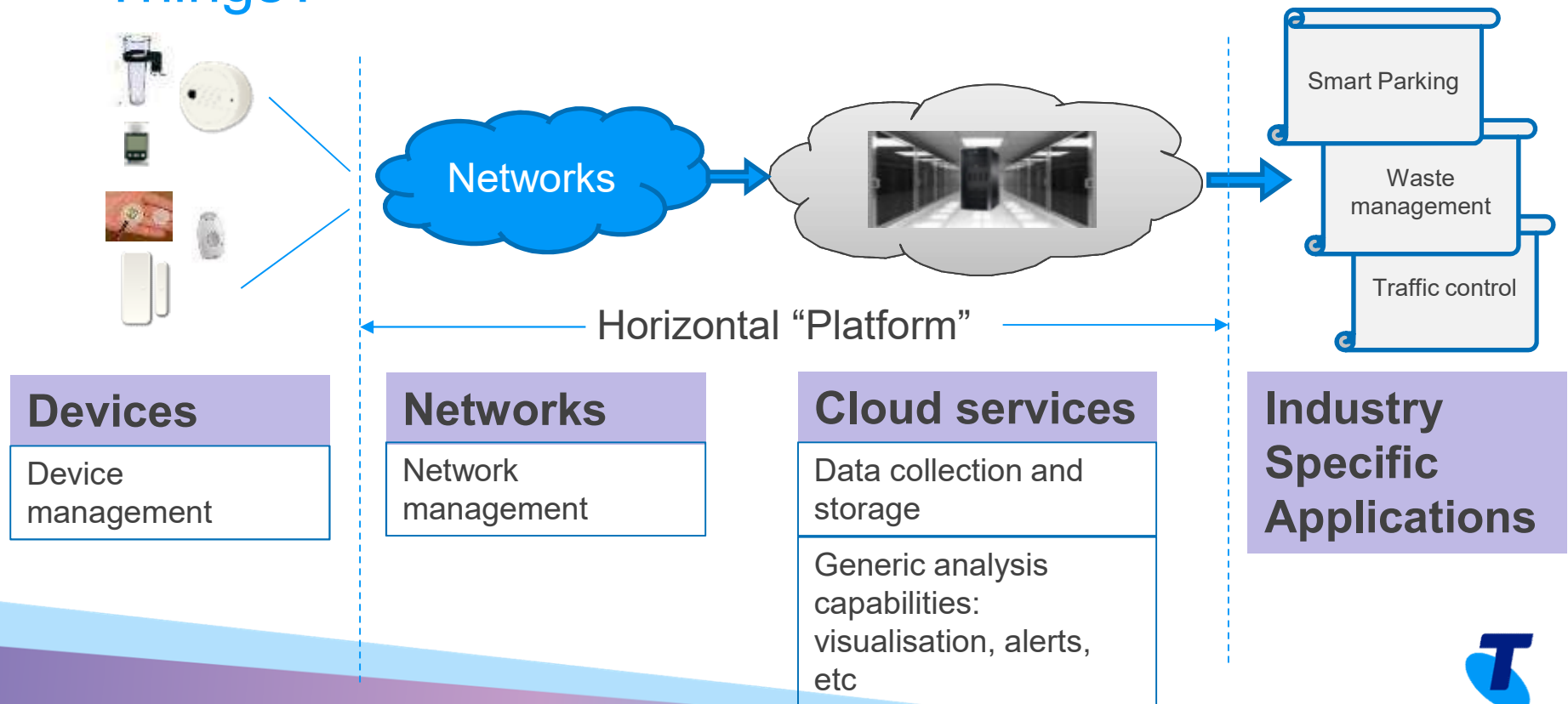
The Internet of Things (IoT): Devices

Everything that can be measured, will be measured

Today, more than 99% of things are still not connected*

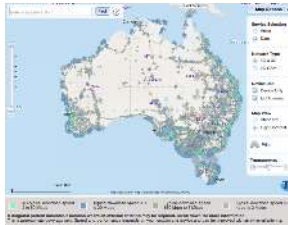


What is involved in creating the Internet of Things?

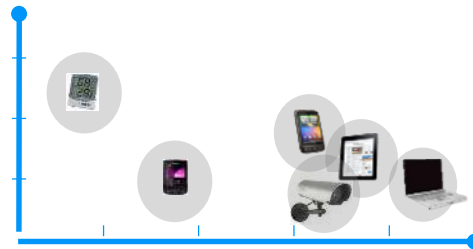


IoT Network Requirements

COVERAGE



CAPACITY



POWER AND BATTERY LIFE



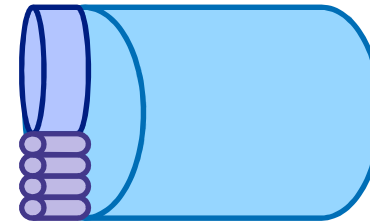
MOBILITY



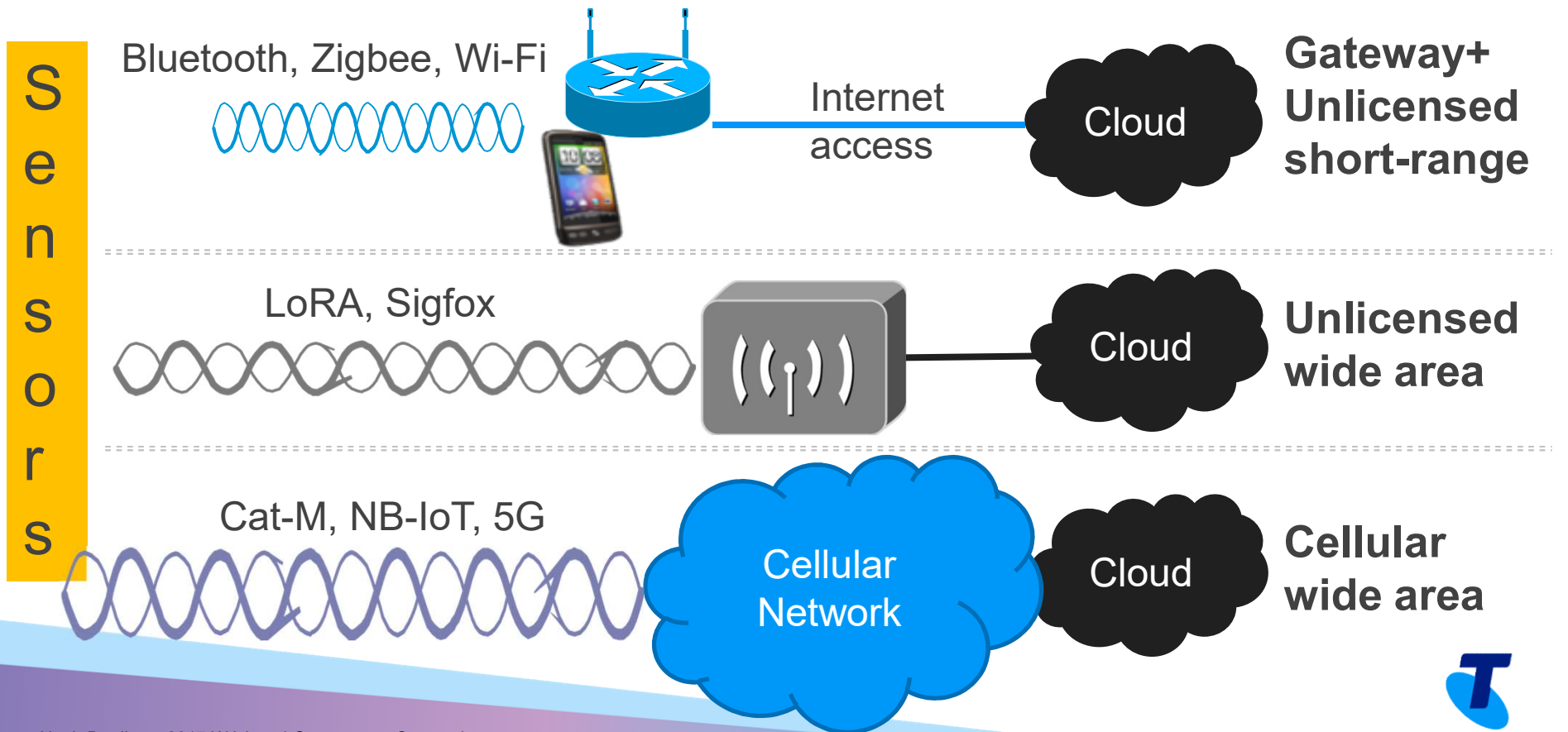
LATENCY



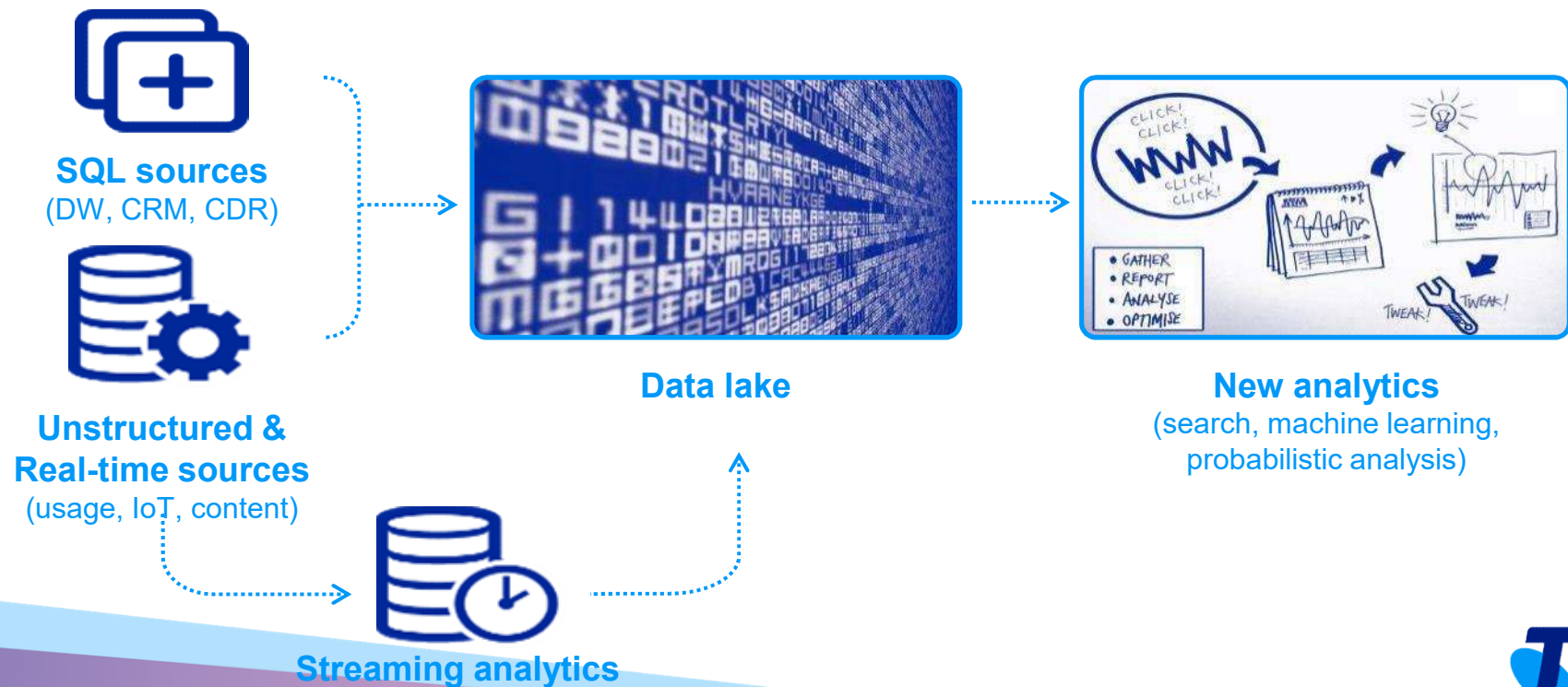
CONSISTENCY (QOS)



IoT networks



Abundant Computing -> Abundant Data -> New Analytics = Artificial Intelligence



How does this apply to Road infrastructure?



3 Major Changes in personal transport

Cars-as-a-service



Picture: Wikimedia Commons - https://commons.wikimedia.org/wiki/File:Zipcar_at_Reserved_Spot_in_Baltimore_Maryland.JPG

Electric drivetrain



Picture: Wikimedia Commons - https://commons.wikimedia.org/wiki/File:Electric_car_charging_Amsterdam.jpg

Autonomous Vehicles



Picture: Creative Commons - Smoothgroover22 <https://www.flickr.com/photos/smoothgroover22/15104006386>

Mobility-as-a-Service

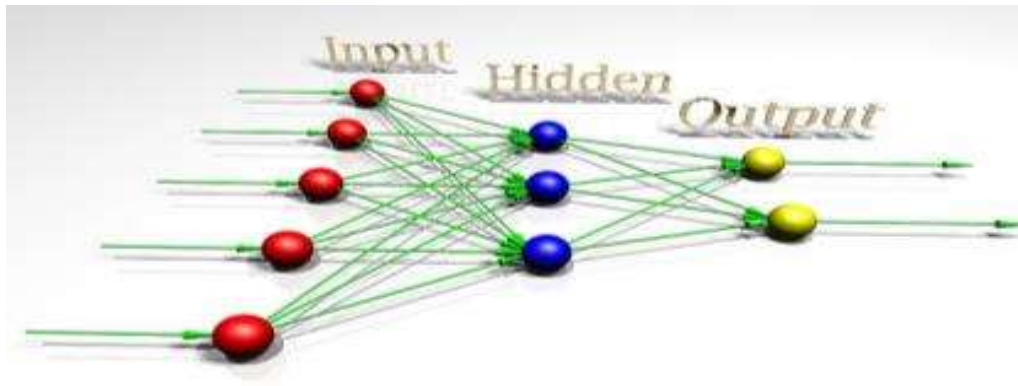


Achieving a transport system without human error – Level 5 autonomy



What will it take?

1 - Machine learning and algorithms



Picture: [fdecomite under Creative Commons](#)

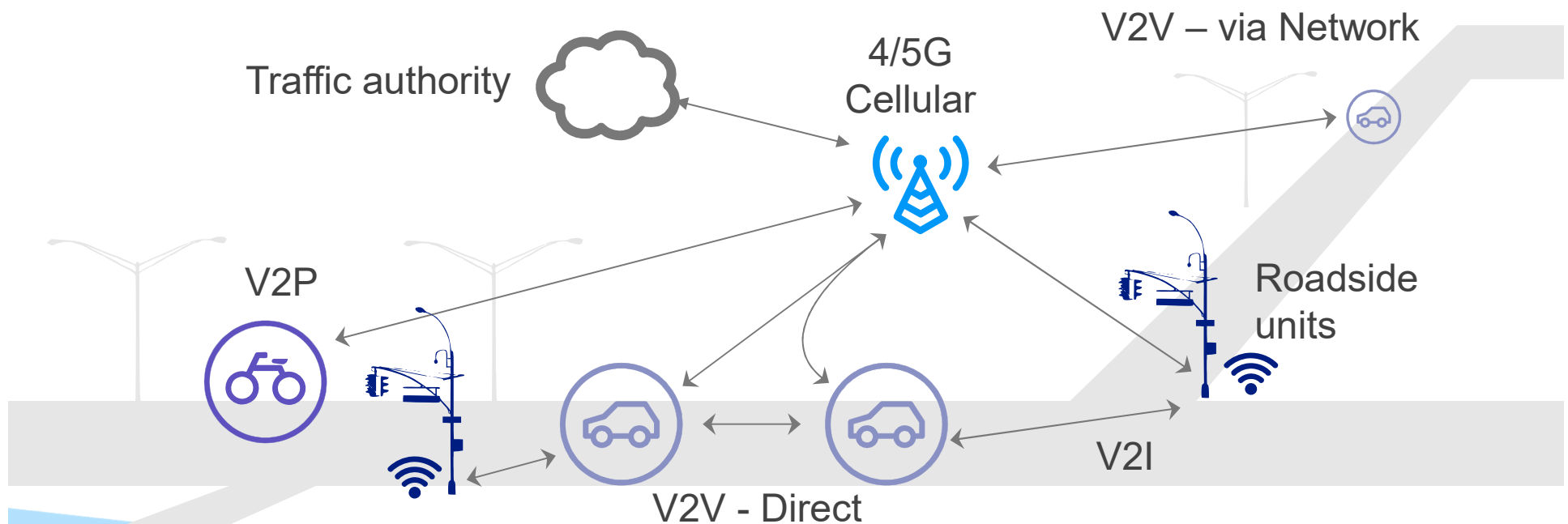
What will it take?

2 – Situational awareness technologies



What will it take?

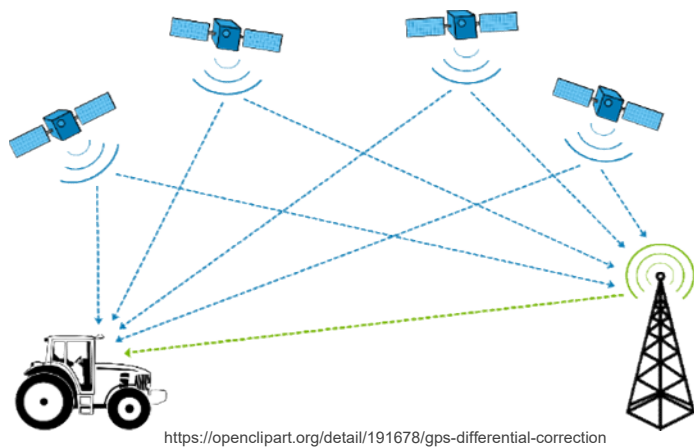
3 - V2X Communications



What will it take?

4 – Centimetre-accuracy maps

Differential GPS



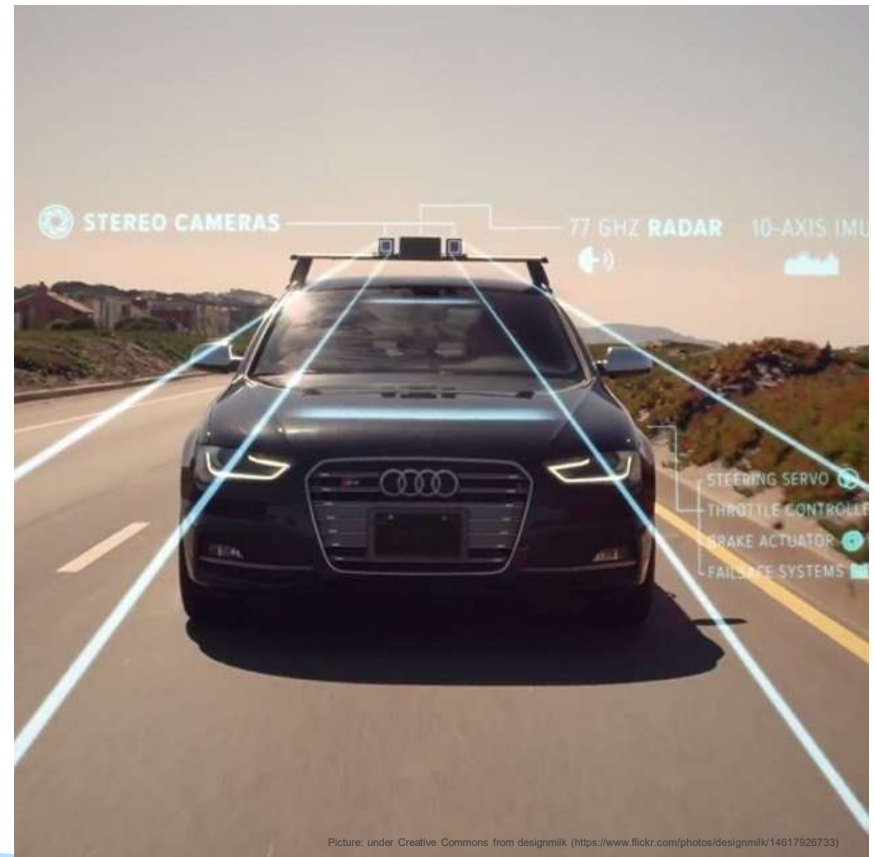
Crowdsourced Edge Mapping



What about the existing fleet of cars?

➤ **Aftermarket kits**

- Cruise Automation
(now GM)
- Comma.ai



Picture: under Creative Commons from designmilk (<https://www.flickr.com/photos/designmilk/14617926733/>)

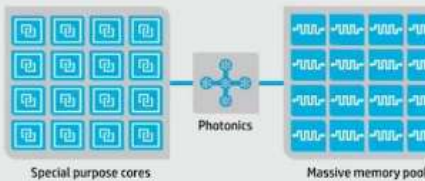
What are the challenges?



New computer architectures for Artificial Intelligence

Rebooting Computing

The Machine



Quantum Computing



Cybersecurity: IoT creates new challenges

- **Encryption**
 - Low processing power (to avoid battery drain) and difficult to implement network encryption
- **Authentication:**
 - Easy to enrol in bot network for DDOS attacks
- **Physical vulnerability**
- **New attacks**
 - Denial-of-sleep
- **Data leakage**
 - E.g. smart meters
- **Scale**
 - Millions of devices
- **Device longevity**
 - E.g. WinXP on many devices



Picture under Creative Commons from https://commons.wikimedia.org/wiki/File:Diana_System.jpg

Security is currently an afterthought –
Yet consequences of an attack are serious



IoT security:

It is not insuperable but must be addressed

- **Security by design**
- **Secure communication channels**
- **Mutual authentication – device to user and vice versa**
- **Firmware updates**
- **Signed software**
- **Activity masking**

Why we need to remove human drivers from the road system



Saving Lives

- **94% of road accidents are due to human error**
- **Today on Australian roads per year, approximately:**
 - 1,200 people die
 - 50,000 people sustain hospitalisation injuries
- **If we assume (conservatively) that AV's would avoid 90% of accidents:**
 - ~1,000 lives saved per year
 - ~45,000 hospital admissions avoided
- **In addition, cars that don't crash can be built out of lighter materials and save energy**

Sources:
<http://www.nrd.nhtsa.dot.gov/pubs/812115.pdf>

Australian Government Department of Infrastructure and Regional Development, "Statistical Report: Road Deaths Australia, 2013 Statistical Summary", http://www.bitre.gov.au/publications/ongoing/files/RDA_Summary_2013.pdf
Australian Government Australian Institute of Health and Welfare, "Serious injury due to land transport accidents, Australia 2008-2009", <http://www.aihw.gov.au/publication-detail/?id=10737421997>



Changed user experience



Video with permission of Professor Gerhard Fettweis, Vodafone Chair at Technical University of Dresden, pioneers of the “Tactile Internet”

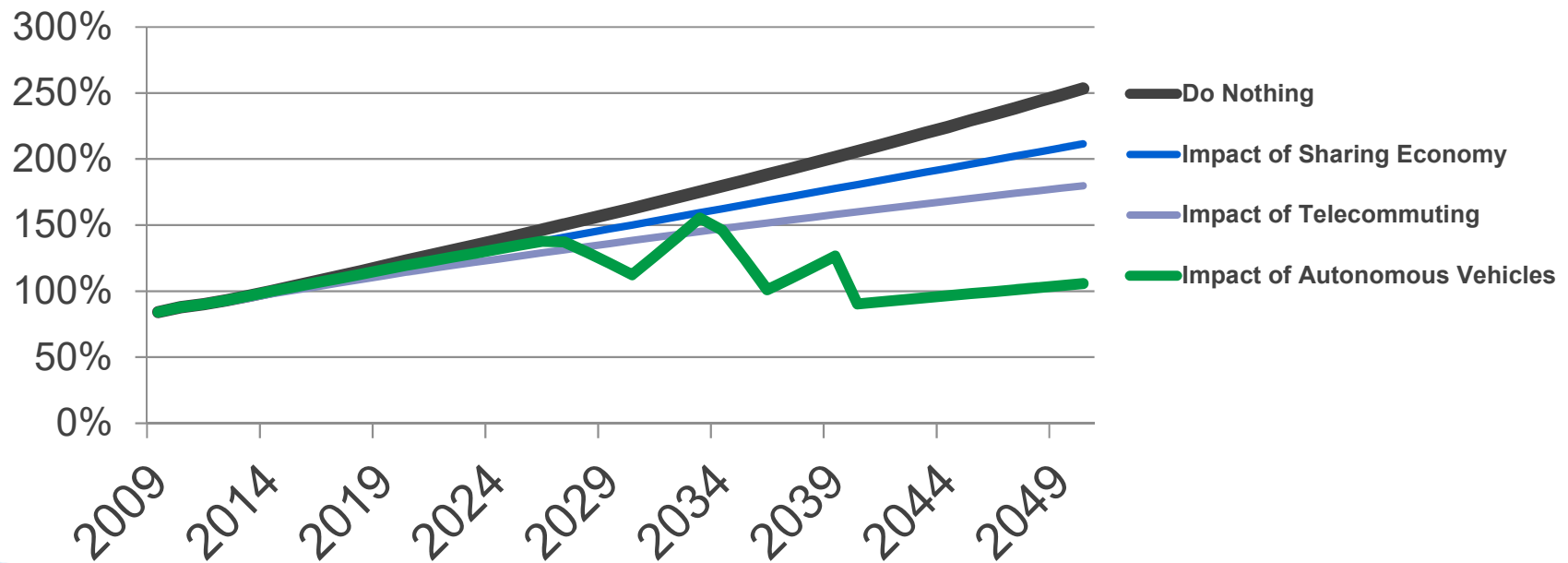


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Infrastructure: Digital replaces physical

Road capacity growth in Australia (normalised to 2014 values)



What is next (after the technology)?



Key considerations

- **Introduction strategies from Level 3 to Level 5**
- **Safety standards**
 - Vehicle Minimum technology requirements for situational awareness
 - V2X Communications
 - Mapping and location
 - Cyber security
 - Failsafe requirements
 - Testing and compliance
- **Data standards**
 - Telemetry for road optimisation
 - Data logging for crash investigation
 - Data ownership

Conclusion



A full automated transport system can:

- **Save lives and the hospital system**
- **Reduce infrastructure costs**
- **Save private capital tied up in cars**
- **Save time in the economy through journey predictability and congestion minimisation**
- **Provide transport equity to everyone**

The Technology Solutions are emerging to make this possible

Councils have a key role

- **Transition strategies for Autonomous Vehicle introduction**
 - Zones
 - Lanes
 - Pedestrian interaction
- **Determining the mix of private and public vehicle ownership**
 - Driving the uptake of MaaS
- **Determining the mix of battery and internal combustion engine vehicles**
 - Pollution control
- **Planning the new road system**

Thank you

