



# DAB radio interference

How to assure a pleasant driving experience ?

Thierry Boitel

Director

Toyota Motor Europe

R&D Electronics Engineering



- Toyota introduction
- DAB radio customer's satisfaction
- Interference cases
- Toyota DAB antenna example



Established in **1937**

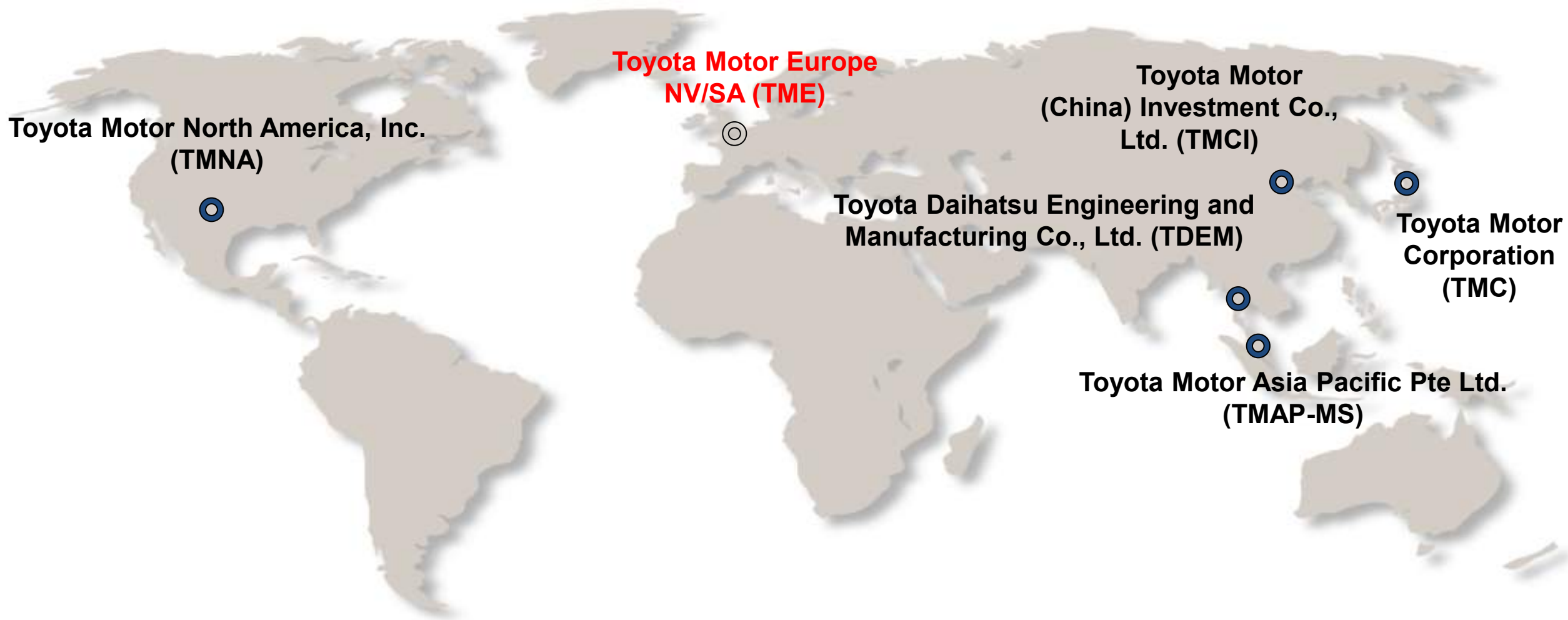
**53** manufacturing companies in **28** countries and regions, outside of Japan

Vehicles sold in more than **170** countries and regions worldwide

**10.594** million vehicles sold worldwide in CY 2018

More than **13** million cumulative **hybrid sales**

Around **370,000** employees worldwide





Toyota C-HR (Hybrid)



AYGO



Yaris (Hybrid)



Camry



RAV4



Toyota Corolla  
Hatchback (Hybrid)



Corolla Sedan  
(Hybrid)



Toyota Corolla  
Touring Sports (Hybrid)

Main vehicles produced in Europe



## Toyota Technical Centre – Zaventem – Belgium-





1. Radio **Tuning**
2. Keep up to date to the **Environment** rapid change
3. Protection against **radio interference**

## Tuning



Supplier  
OEM

## Environment

### Broadcasters

- Power
- Infrastructure
- More channel
- Linking technique

## Radio interference Protection

INSIDE car  
All electronic equipment  
in the car

OUTSIDE car  
Everything





## Interference from outside



International standard  
(CISPR, IEC)

## Interference from Inside



International standard (CISPR, IEC)  
Toyota standard



Impact on reception performance caused by additionally accessories in the vehicle



# Real case complaint



I find some stations better than others but yes, signal does drop out but I don't know whether that's down to living in a hilly area.

I have a dashcam fitted

Do you have a dashcam or any phone charger or anything plugged into the 12v sockets?



Can you disconnect the dashcam and check reception?

No problem anymore

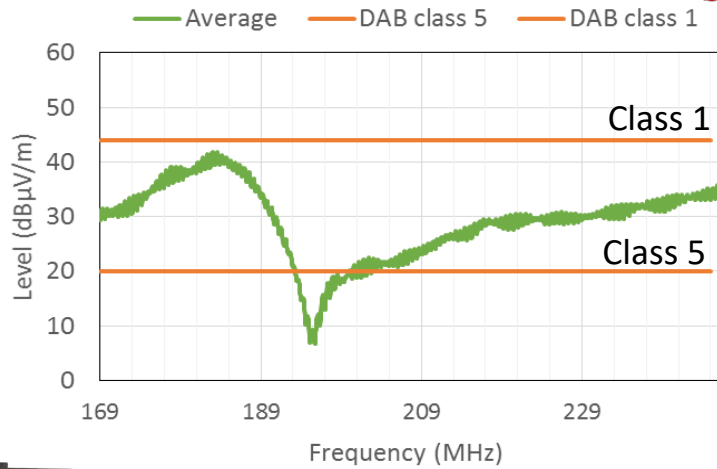


Need to reflect customer voice

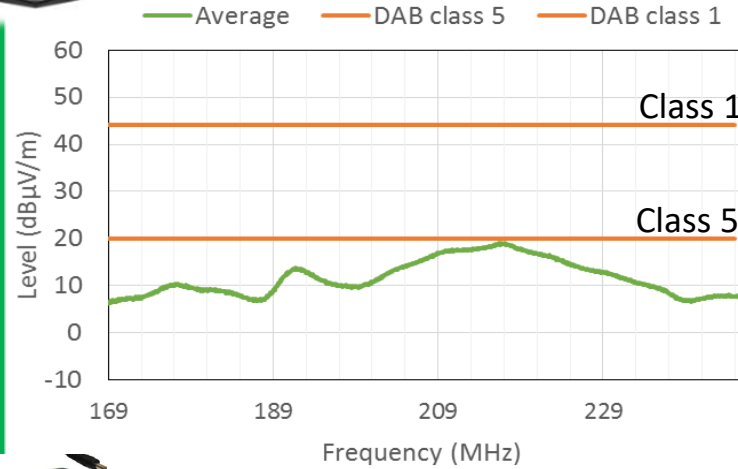
Source: [www.chrforum.co.uk](http://www.chrforum.co.uk)



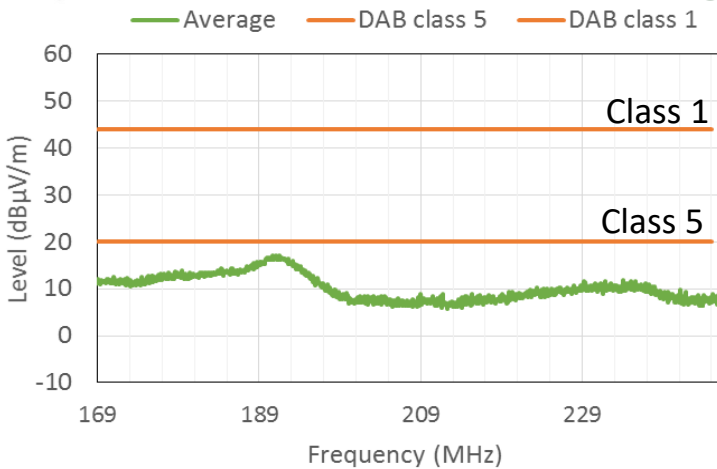
Sample 1 - CISPR 25 Benchmeasurements



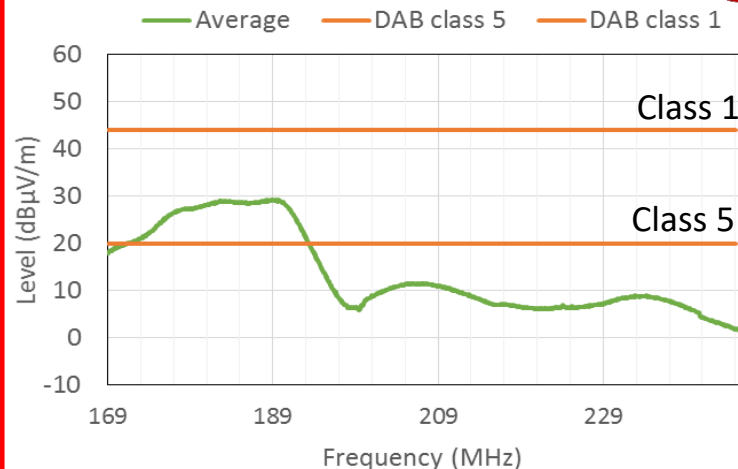
Sample 2 - CISPR 25 Benchmeasurements



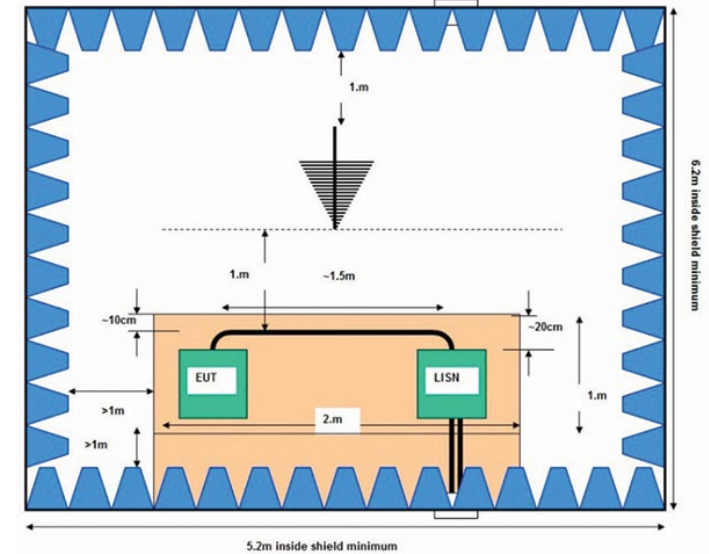
Sample 3 - CISPR 25 Benchmeasurements



Sample 5 - CISPR 25 Benchmeasurements



## Test setup for radiated emission



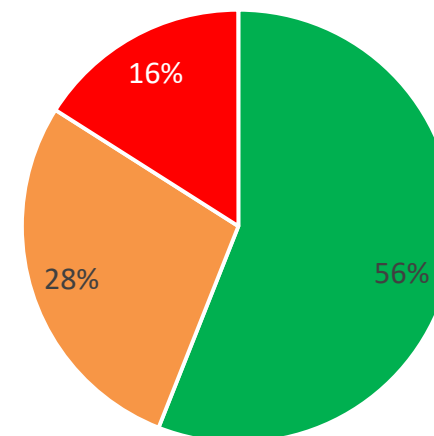
Some equipment does not achieve EMC criteria



Market Surveillance Example from German regulator –  
online trade interventions per product category

| Rank | Category                                  | Stops of Online Sales |
|------|---|-----------------------|
| 1    | Radio headphones                          | 338,272               |
| 2    | Drones / Quadrocopters                    | 64,134                |
| 3    | Smartwatches                              | 19,884                |
| 4    | Radio transmitters (e.g. portable FM Tx') | 17,194                |
| 5    | Backup cameras                            | 3,085                 |
| 6    | Remote-controlled sockets                 | 2,210                 |
| 7    | Audio mixers                              | 2,029                 |
| 8    | Hand-held radios                          | 1,751                 |
| 9    | LED lamps                                 | 1,181                 |
| 10   | e-cigarettes                              | 1,173                 |
| 11   | Surveillance cameras                      | 1,063                 |
| 12   | Radio door bells                          | 971                   |
| 13   | Mobile radios                             | 833                   |
| 14   | Radio alert systems                       | 369                   |
| 15   | Bluetooth applications                    | 259                   |
| 16   | others 1                                  | 218                   |
| 17   | others 2                                  | 202                   |
| 18   | Multimedia equipment                      | 158                   |
| 19   | Alarm clocks                              | 148                   |
| 20   | Game pads                                 | 138                   |
| 21   | HDMI switches                             | 100                   |
| 22   | USB chargers                              | 99                    |
|      | others 3                                  | 284                   |
|      |   | <b>455,755</b>        |

EMC issues

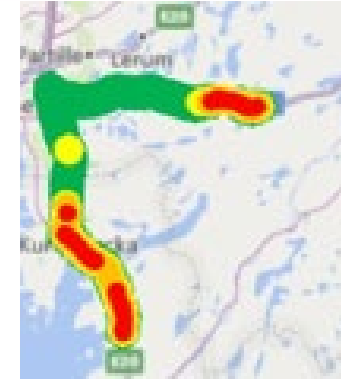


■ Small risk ■ Medium risk ■ High risk

Source: BundesNetzAgentur.  
Statistik Marktüberwachung 2017



Toyota is monitoring the environment change: infrastructure change by checking WorldDAB page and measurement on site



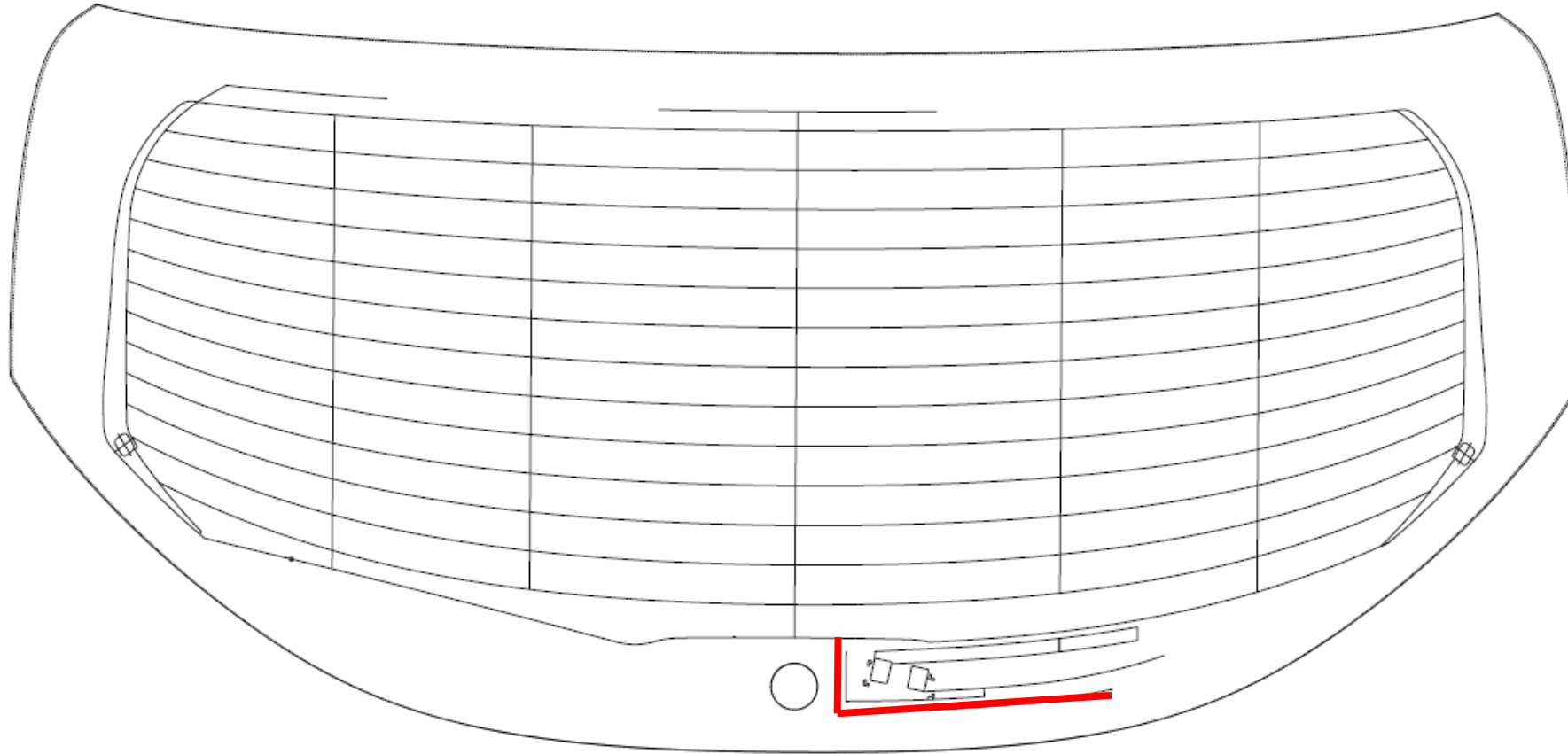
Toyota has introduced rear glass DAB antenna in latest models



Toyota is keen to open discussion with other stakeholder (via WorldDAB forum)



## Corolla 2019 - Rear glass DAB antenna



Toyota has put the antenna position in the rear glass to secure DAB reception performance



- Interferences generated by some accessories in the DAB band.
- Need to continuously monitor the market changes & requirements
- “World DAB” key information exchange platform toward customer’s satisfaction



*Thank You!*