



Status quo and trends on in-car DAB reception

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WorldDAB Steering Board initiative: performance work group

- Part of the UX workgroup
- Performance benchmarks being done in several countries: align and coordinate
- Bringing together experts to address in-car DAB reception challenges
- Clarify required performance levels for car manufacturers (in the drafting stage)
- Alignment meetings with OEMs started
- Define material, support and cooperation to maintain good in-car DAB reception
- Current active members:
DigitalRadioUK, NRK, DABItalia, SRG, Arqiva, BBC, NXP

DAB reception in cars



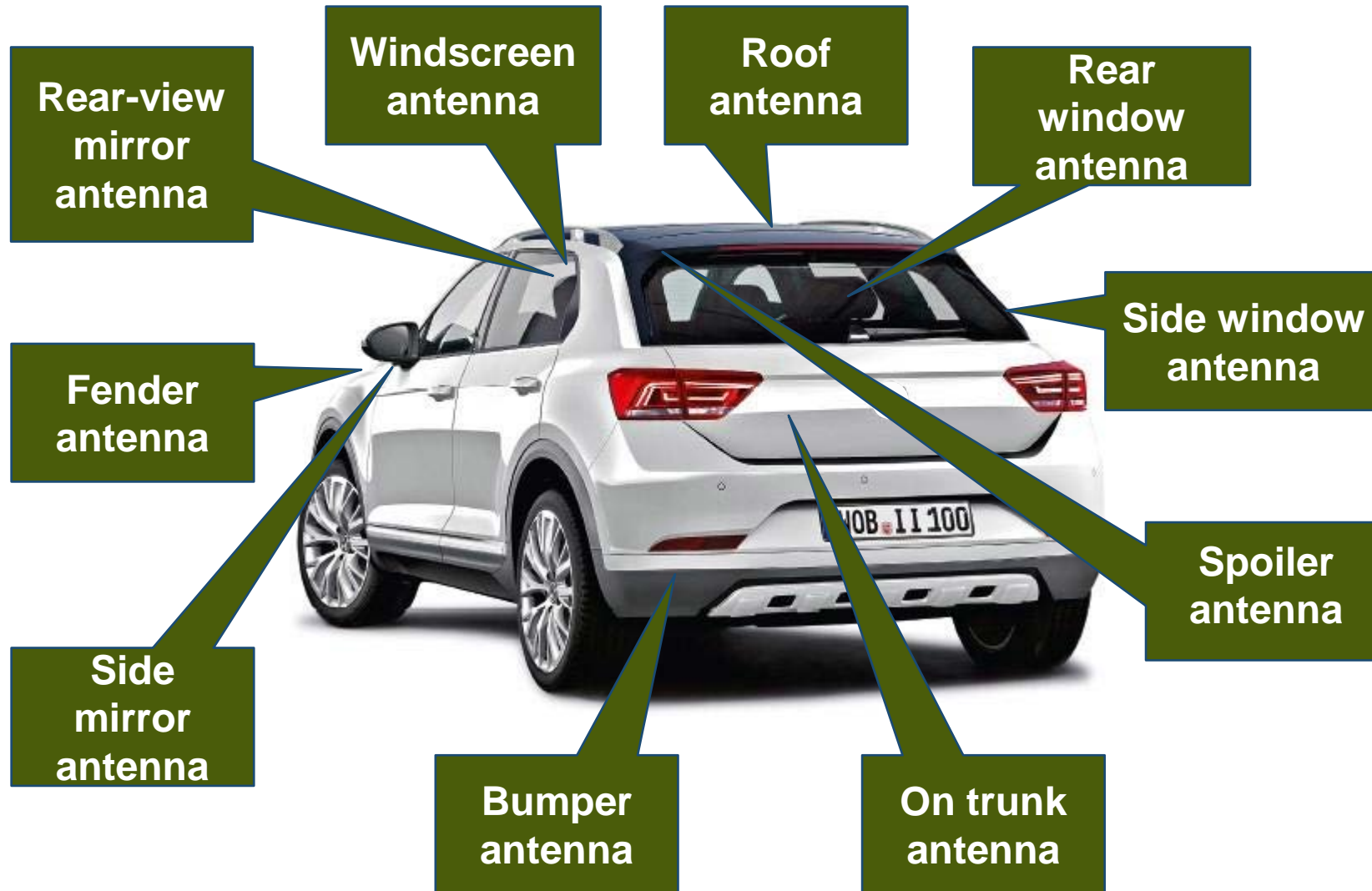
- DAB networks are maturing in many countries (UK, Norway, NL, Germany, Italy, CH, ...)
- Broadcasters utilize the DAB capabilities: more and unique content, audio + visuals
- Latest DAB chips lower cost offering performance and more features & functions

- All signs are on green to offer a good user experience



- However, the challenge to get good in-car DAB reception is increasing significantly
- This trend is driven by :
 - increased levels of radio interferences
 - non-rooftop antenna systems with lower sensitivity

Antennas can be all over the car



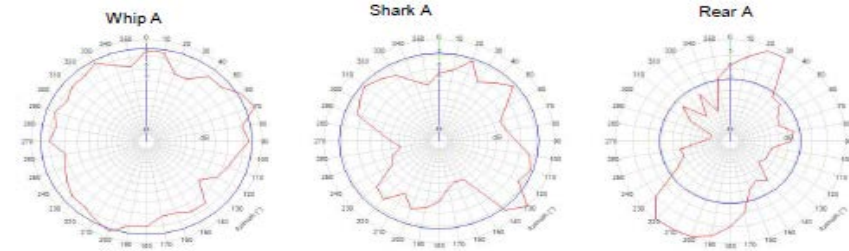
Mostly used locations:

- Entry level: Roof (rod)
- Main stream: Roof (rod, sharkfin)/Glass
- Luxury cars: Glass, Sharkfin
- SUVs: Glass, Sharkfin

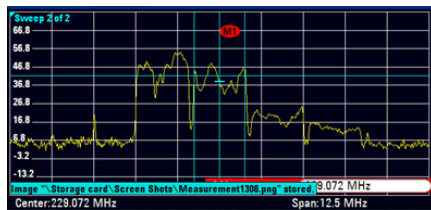
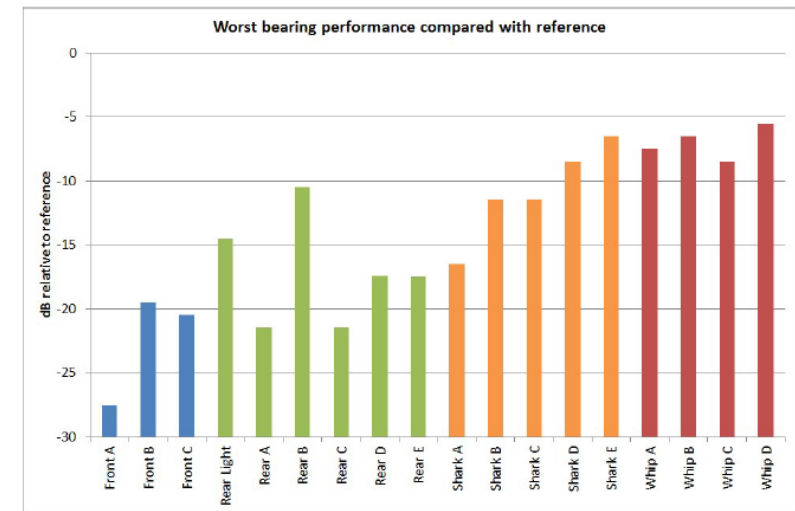
Benchmarks/observations by different WorldDAB members

OEM	Issue			
	Antenna	Sensitivity	C/N	PL
1				
2				
3				
4				
5				
6				
7				
8				
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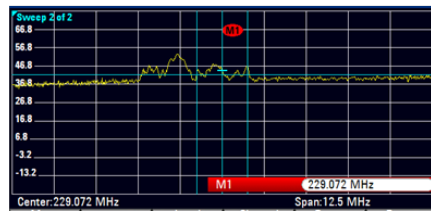
SRG SSR



arqiva



NPK



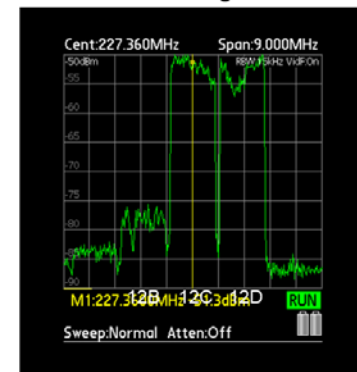
Horizontal glass mounted



Vertically polarised multiplex

Horizontally polarised multiplex (rare case)

Vertical magnetic



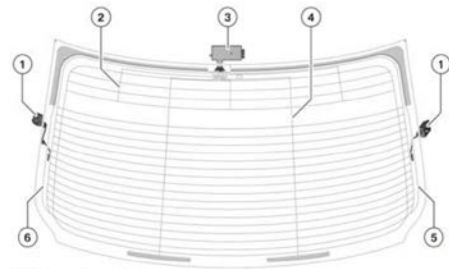
DAB
DAB ITALIA s.p.a.

Trends and consequences

- “Invisible” antennas → C-class and up
- Antenna design has to follow the constraints defined by vehicle designers
- More and more features → LCD screens, LED lighting, cameras

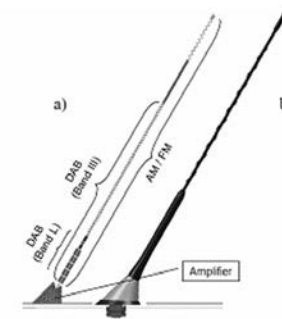
➔ Increasing design challenge → more (wideband) noise and directivity

➔ Lower end cars sometimes outperform higher end cars

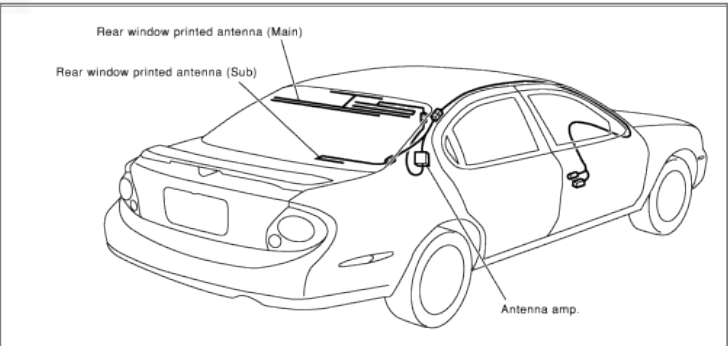
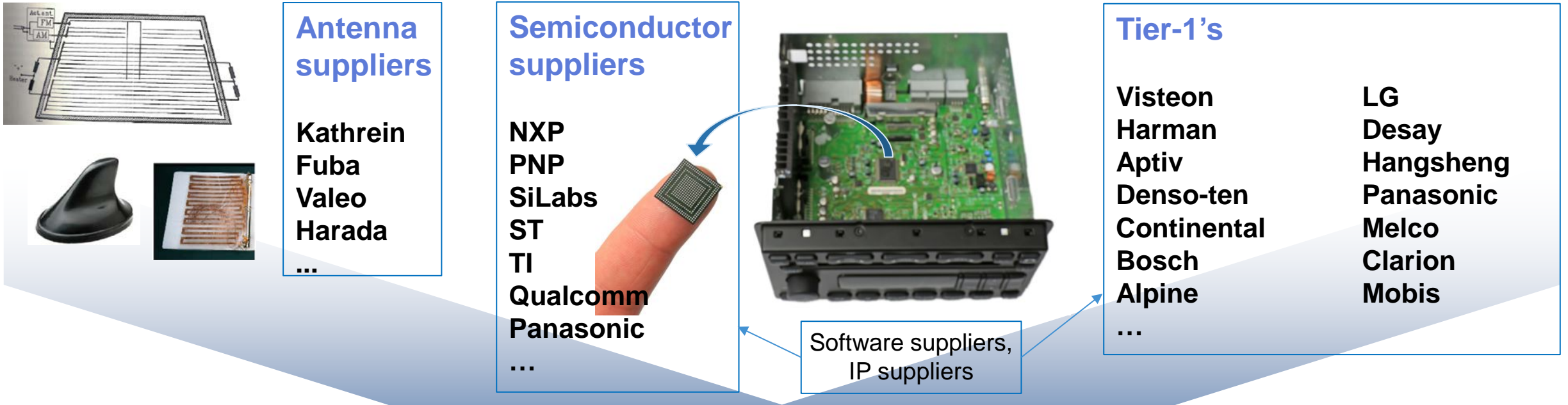


F30 Antenna system, rear window

Index	Explanation
1	Connection of heated rear window to wave trap
2	AM antenna
3	Antenna diversity/Phase diversity
4	DAB Band III antenna (not US)
5	Antenna FM1
6	Antenna FM2



Building an automotive car receiver: who's all involved?



Design guidelines



- **In-car DAB reception**: handle it as a system, cooperation through value chain
- **Noise**: Proper EMC specs for other components
- **Directivity and sensitivity**: Dual antenna applications

- Issue cannot be solved by “just” increasing broadcasting power
 - Incompatible with (inter)national frequency planning
 - Higher field strength cannot always compensate for lower performance of certain antenna types

Conclusions and how can WorldDAB help?

In-car DAB performance shows a downward trend driven by modern vehicle design constraints

How can WorldDAB help?

- Definition of minimum requirements for receiver system design
- Overview of test routes (input broadcasters/network operators)
- Collaboration on testing methods
- (Field)Test support (NRK, SRG, Arqiva, DAB-Italia)
- Bringing together different players in the value chain

Draft DAB receiver performance in-car specification

- Receiver **noise** figure (**lower than 6dB** @ antenna input) for all channels
- Receiver **carrier-to-noise ratio** (for different protection levels and radio-channels, e.g. for PL3A: **6dB for the gaussian** channel, **12dB for the rayleigh** channel (11.5dB for the rayleigh channel acc. ETSI TS 103 461 V1.1.1 (2017-08))
- Receiver **sensitivity (-97.7dBm)** for all channels acc. ETSI TS 103 461 V1.1.1 (2017-08)
- Receiver **return loss (> 12dB)** for all channels (@ 50 Ohms acc. ETSI TS 103 461 V1.1.1 (2017-08))
- **Antenna gain (-5dBd** acc. UK planning **to -10dBd acc.** ETSI TS 103 461 V1.1.1 (2017-08); for channels 5 to 13) / (- 8.1dBi = -10.3dBd)
- **Preamplification** (gain, noise figure, third order intercept) tbd
- **Antenna return loss (> 12dB)** (@ 50 Ohms acc. ETSI TS 103 461 V1.1.1 (2017-08))
- **Antenna diagramm** (horizontal ripple better than 6dB to 9dB for all channels)
- Antenna **polarisation (vertical)**
- Total **man-made noise** coupling power from in-car systems (**max. -106dBm to -115dBm tbd**)
- **Level for muting/linking** (post Viterbi BER higher than $5 \cdot 10^{-3}$); timedelay for muting/linking; hysteresis
- **Receiver selectivity** (adjacent channel interference) acc. ETSI TS 103 461 V1.1.1 (2017-08)) (**desirable 40dB for N+-1**)





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