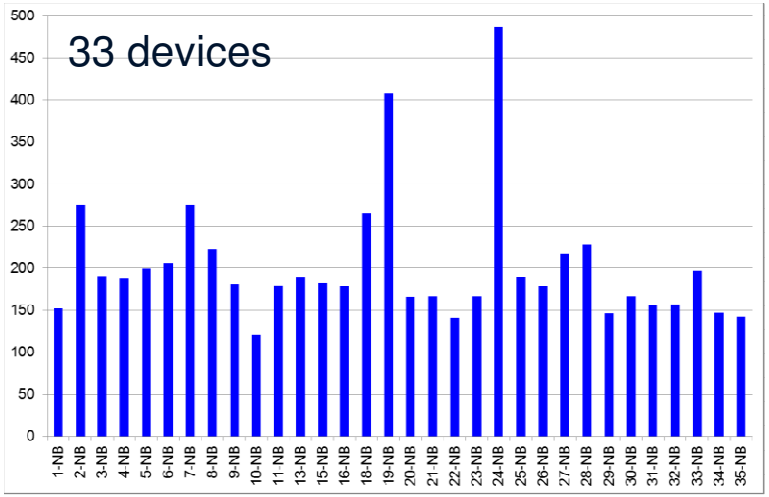
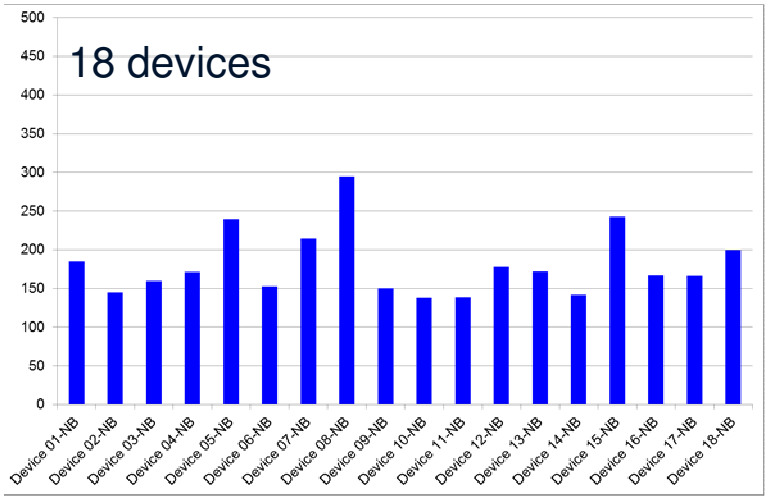
Key Issues and Their Implications for Automotive Industry

HEAD acoustics GmbH

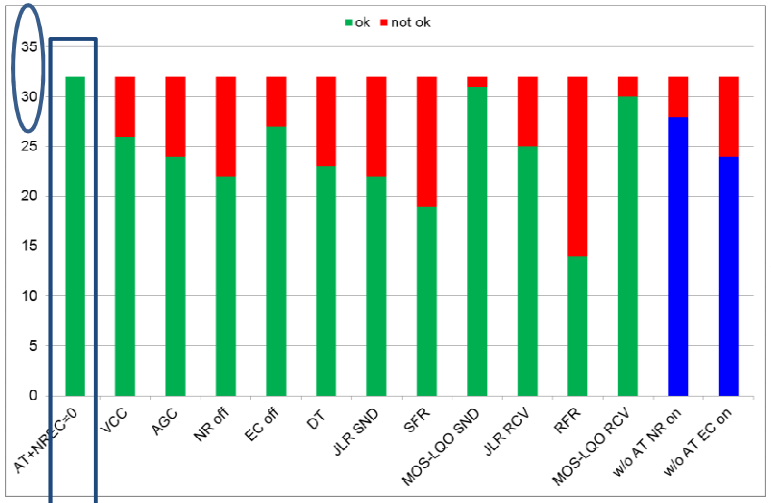
Tendencies - Narrowband

Narrowband Roundtrip Delay

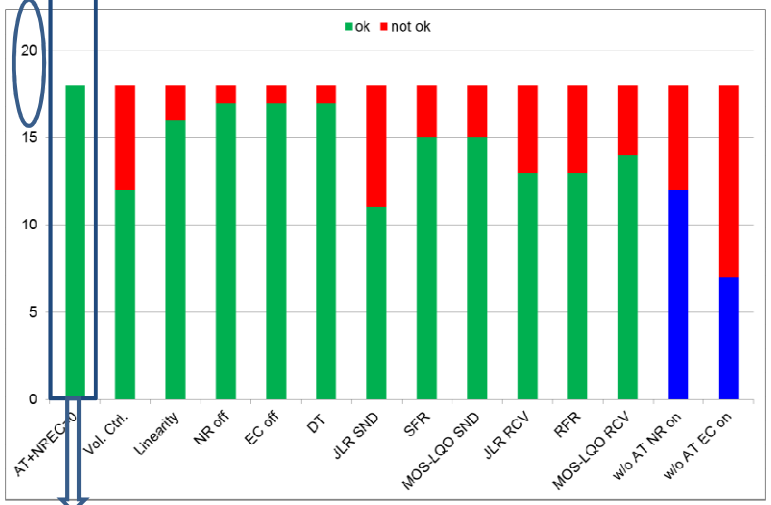




Narrowband Overall Performance



1st Test Event 2014

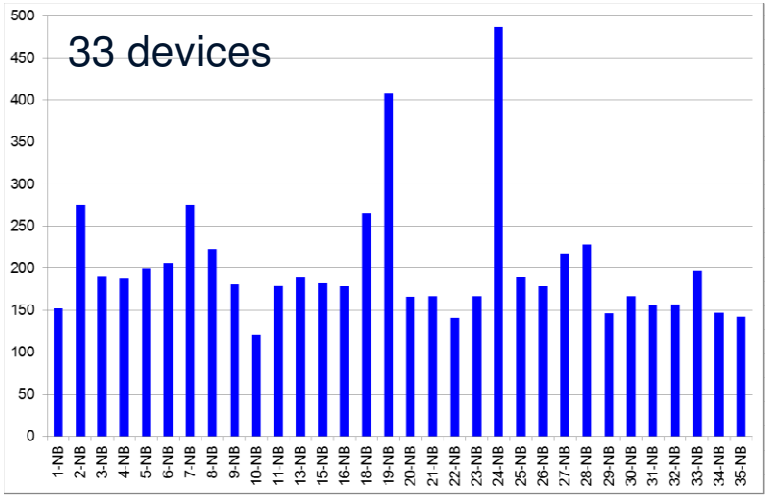


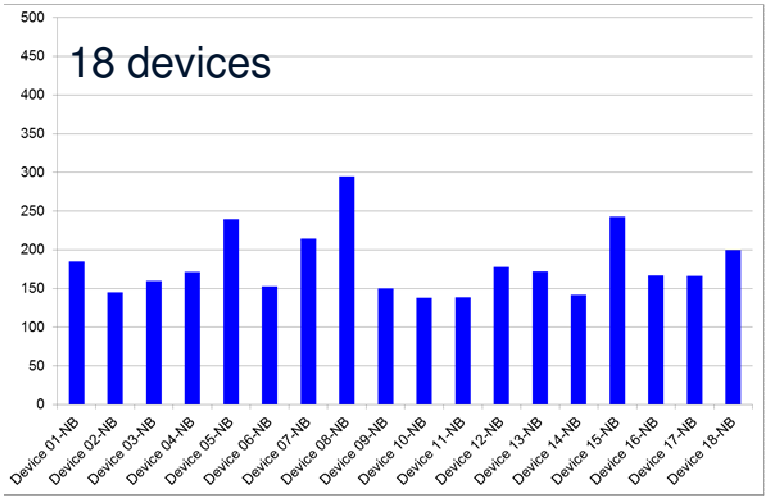
2nd Test Event 2016

All devices support AT+NREC=0

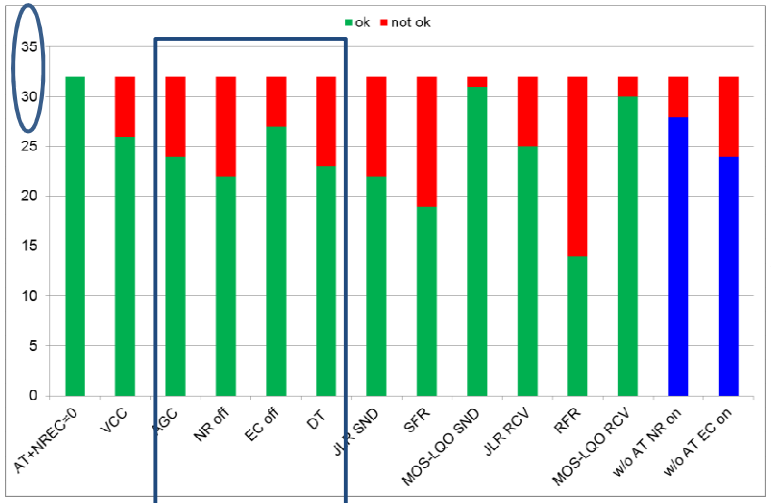
Tendencies - Narrowband

Narrowband Roundtrip Delay

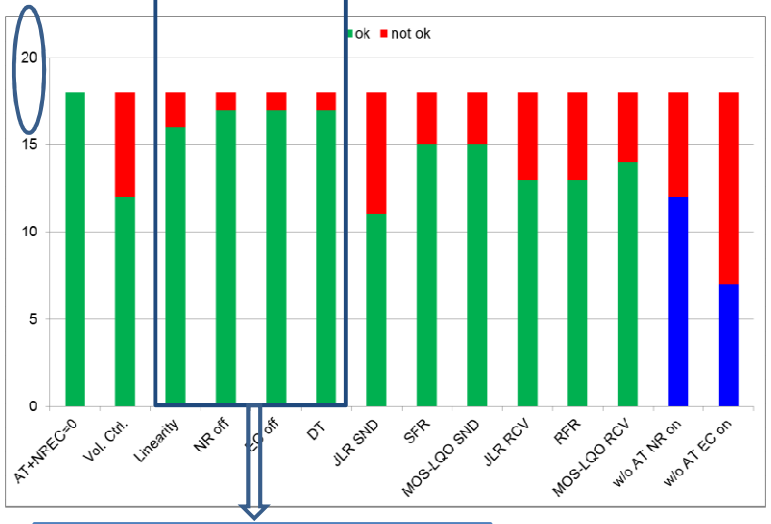




Narrowband Overall Performance



1st Test Event 2014

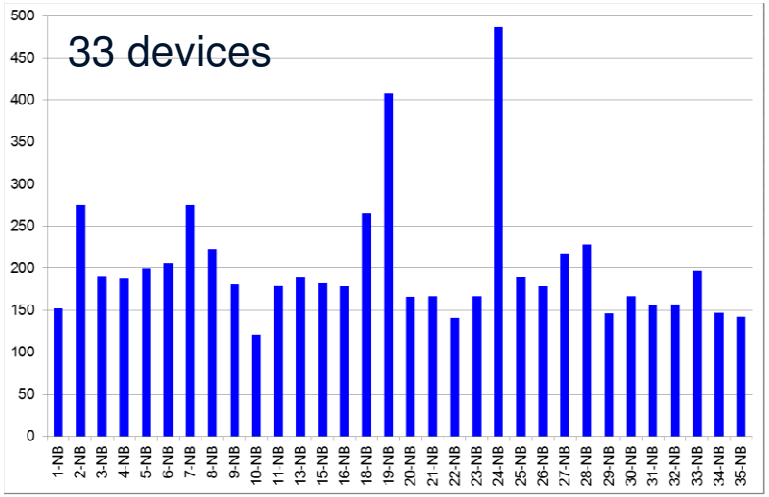


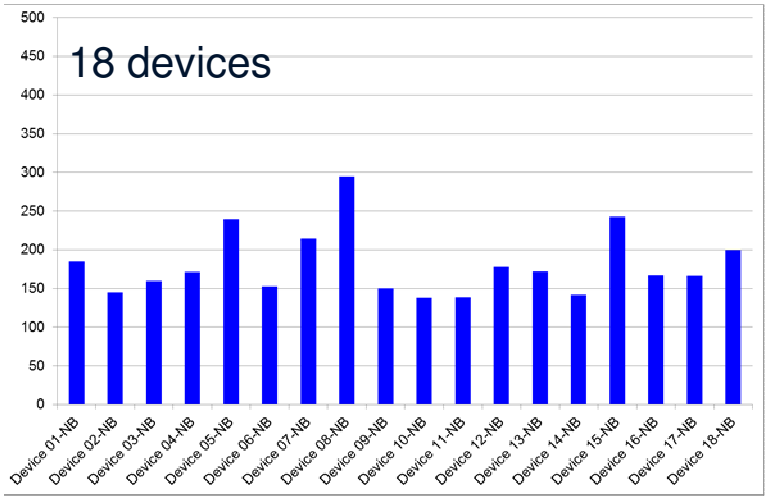
2nd Test Event 2016

Most devices
turn off signal processing

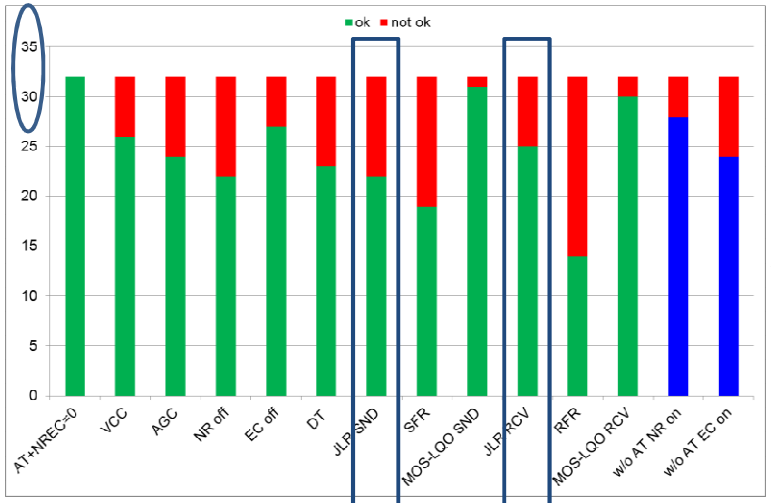
Tendencies - Narrowband

Narrowband Roundtrip Delay

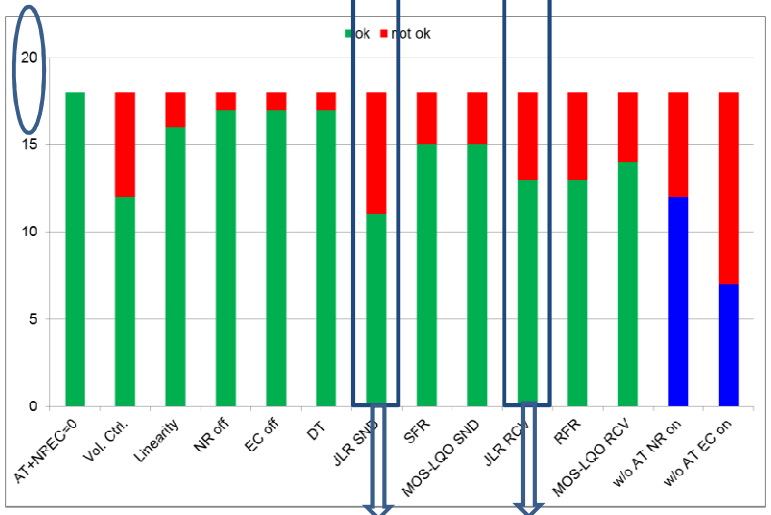




Narrowband Overall Performance



1st Test Event 2014

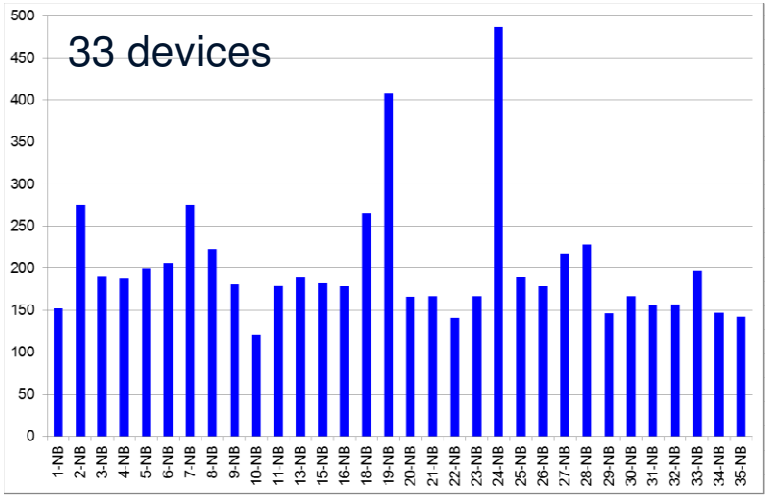


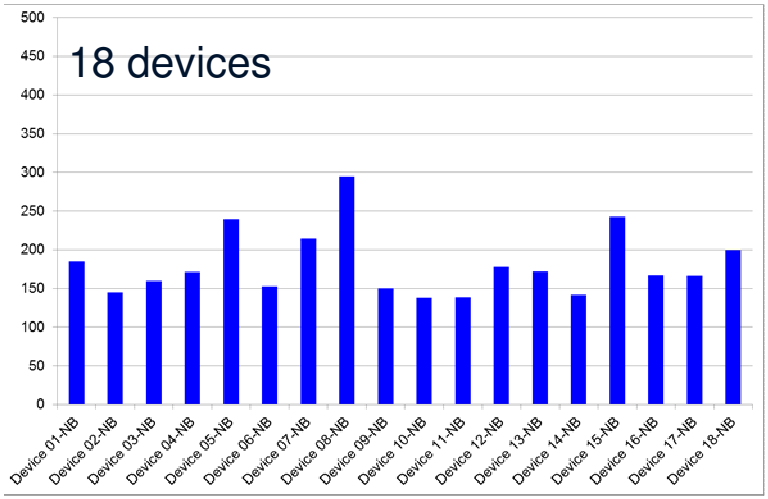
2nd Test Event 2016

Gains often not in range

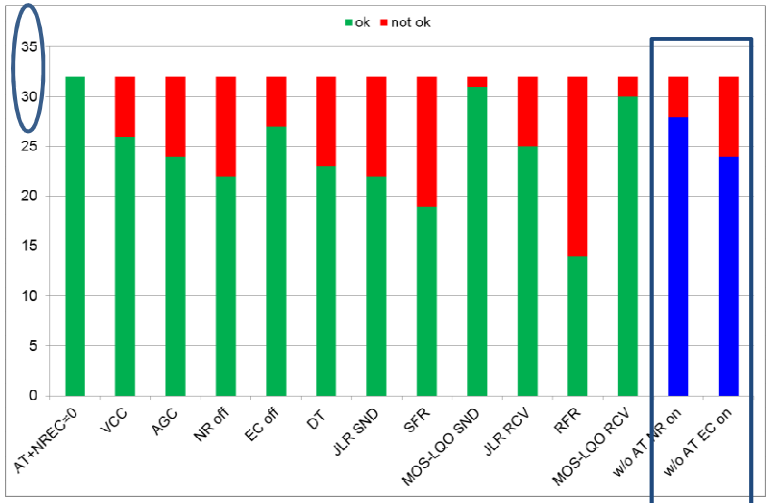
Tendencies - Narrowband

Narrowband Roundtrip Delay

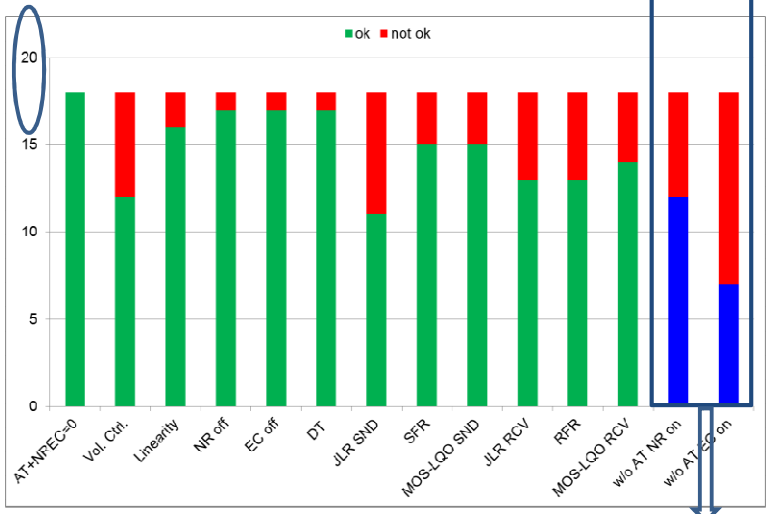




Narrowband Overall Performance



1st Test Event 2014

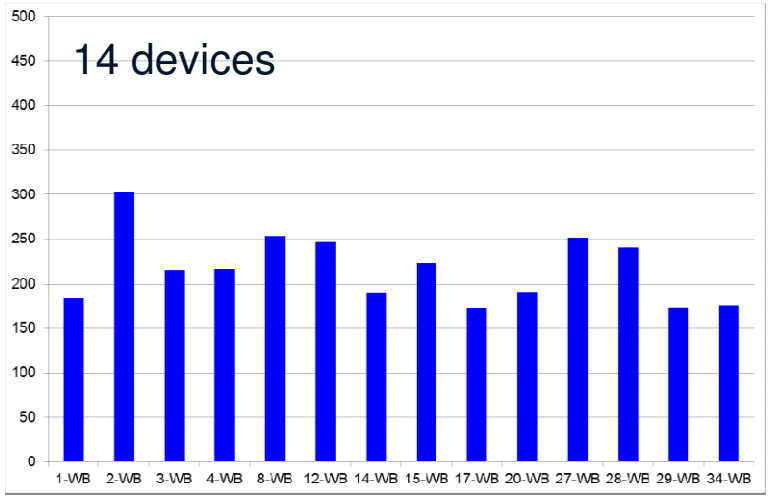


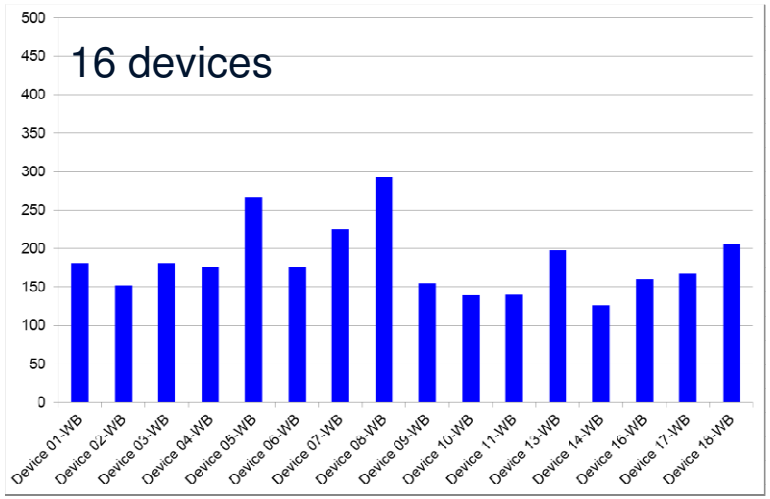
2nd Test Event 2016

Strange tendency to disable signal proc. also when AT command is <u>not sent</u>

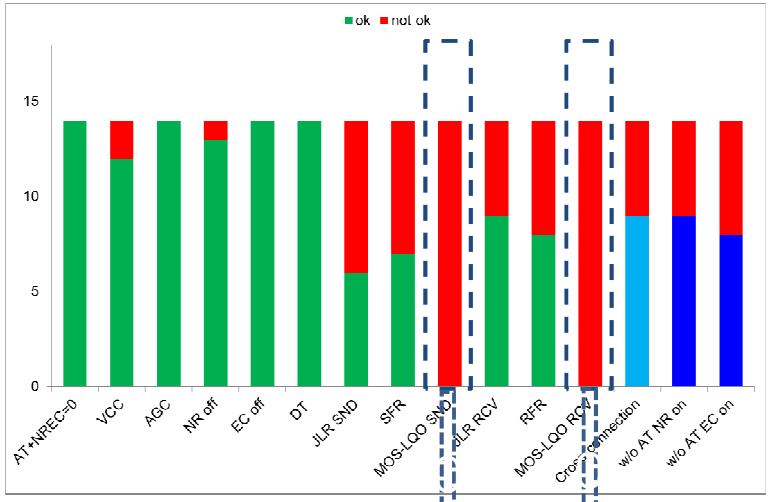
Tendencies - Wideband

Wideband Roundtrip Delay

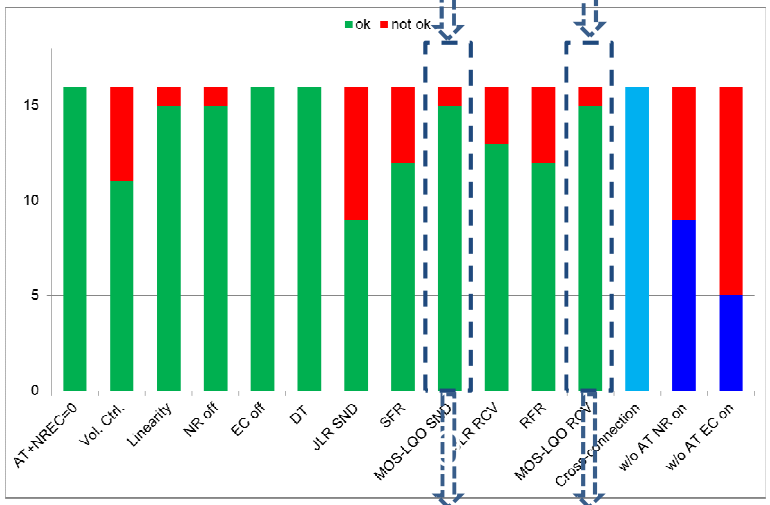




Wideband Overall Performance



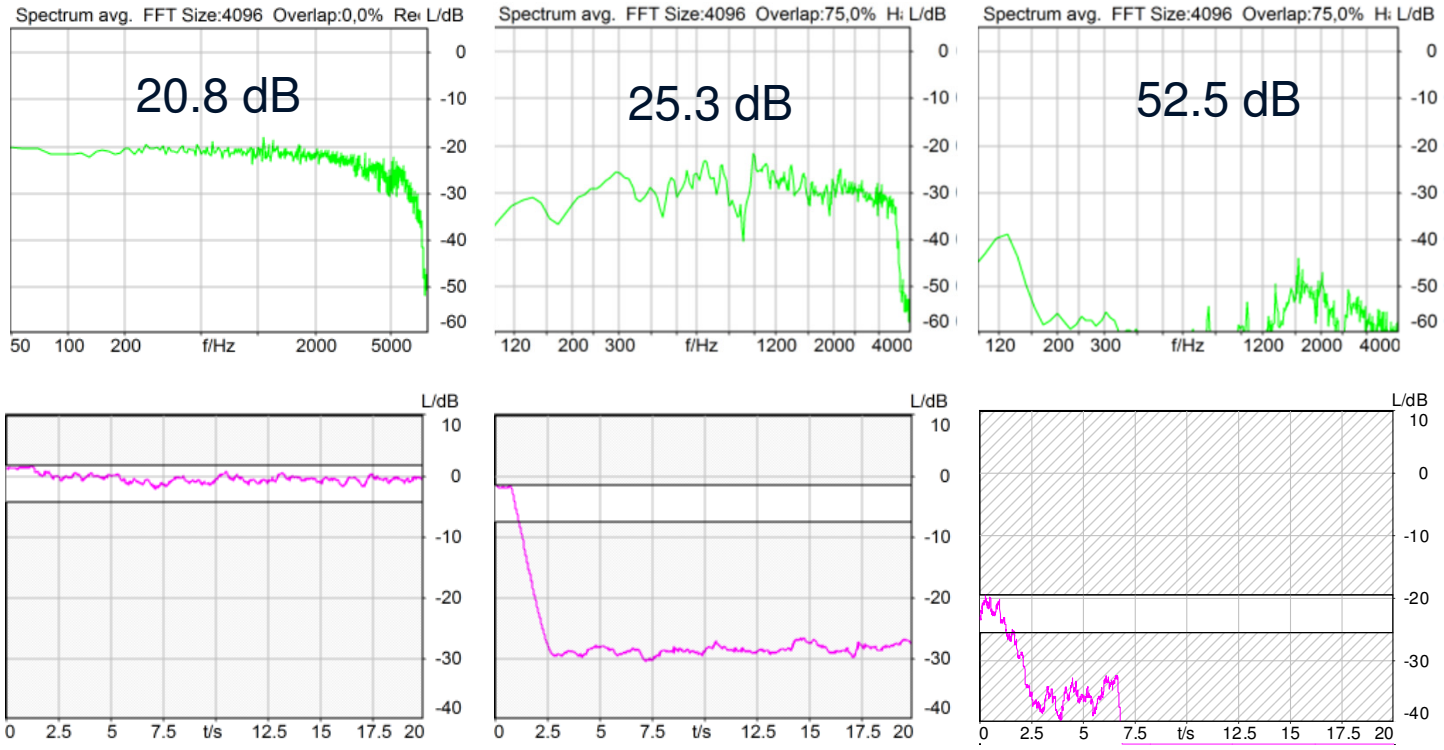
1st Test Event 2014



2nd Test Event 2016

Requirement updated After 1st Test Event

AT+NREC=0 (Bluetooth® HFP)



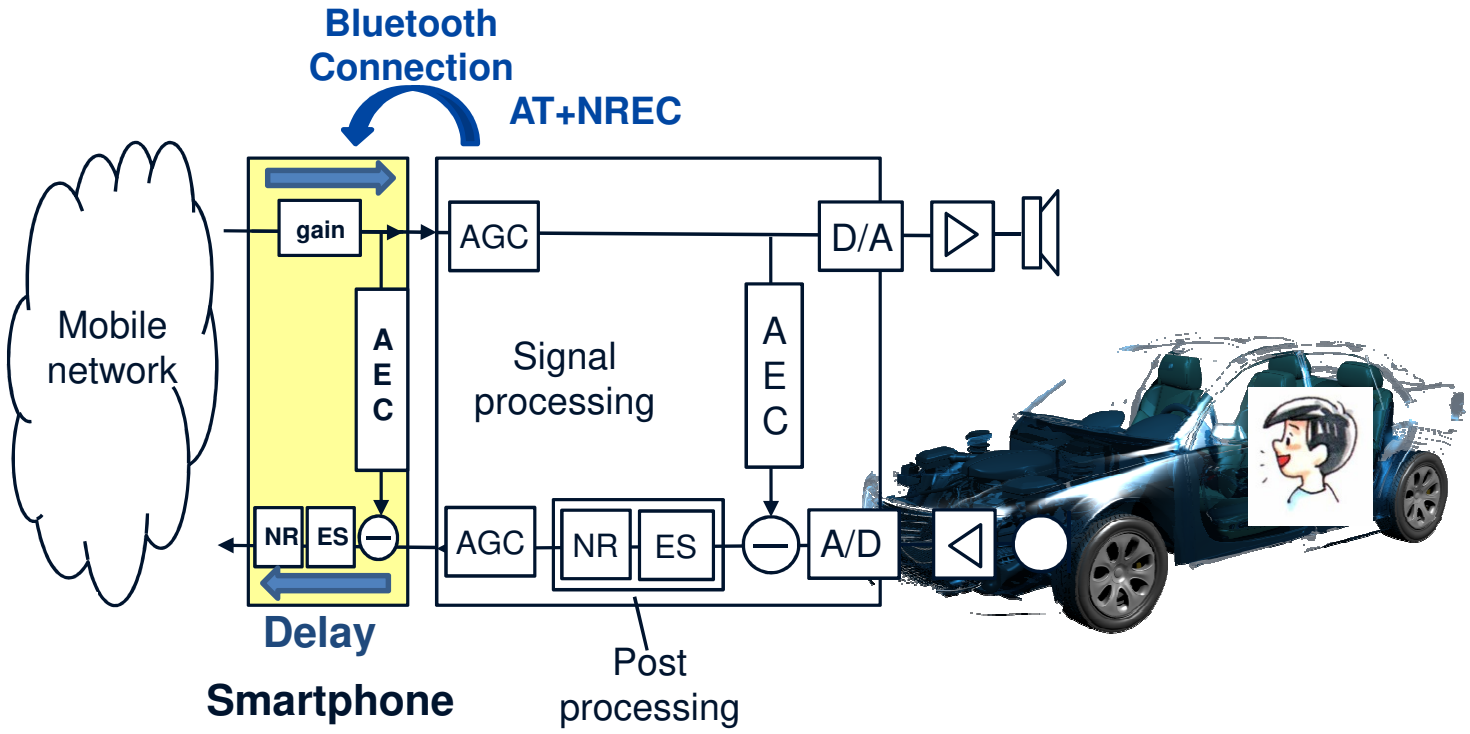
EC Test:
Simulated 20 dB echo path

NR Test:
Application of stationary noise (pink, car)

What about other aspects…

- Equalizers ?
- Gains ?
- Non-linear signal processing e.g. Automatic Gain Control (AGC) ?
- Volume control activity ?

Delay



Roundtrip delay [ms] comparison with and without AT+NREC=0 command sent:

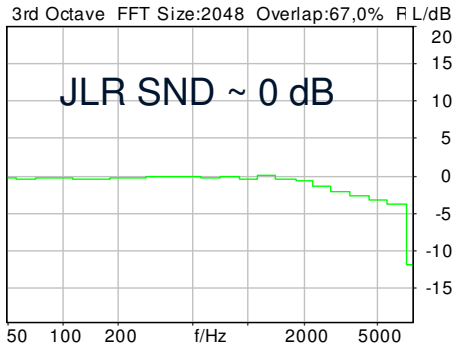
	Device 1	Device 2	Device 3	Device 4	Device 5	Device 6	Device 7	Device 8	Device 9	Device 10
AT+NREC=0 sent	151,7	181,6	175,6	181,7	265,5	174,9	225,0	292,9	154,7	139,3
AT+NREC=0 not sent	166,8	215,0	170,9	173,8	281,5	164,2	238,1	352,8	156,3	140,2
Δ (ATnot sent-ATsent)	**15,1 ms**	**33,4 ms**	**-4,7 ms**	**-7,9 ms**	**16,0 ms**	**-10,7 ms**	**13,1 ms**	**59,9 ms**	**1,6 ms**	**0,9 ms**

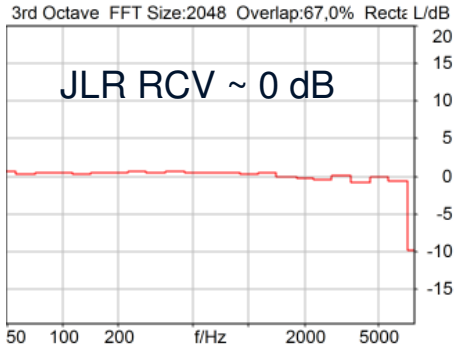
→ AT+NREC=0 does not "bypass" signal processing, delay is typically not reduced.
→ More likely: the DSP is configured into an "idle" configuration (e.g. EC and NR set to 0)

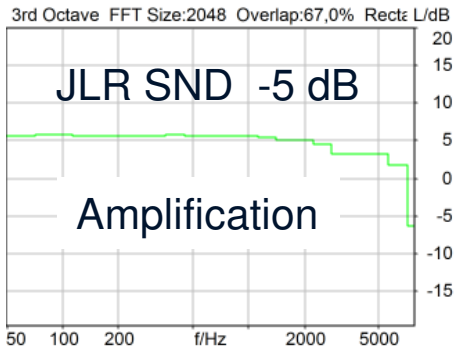
Junction Loudness Rating (JLR)

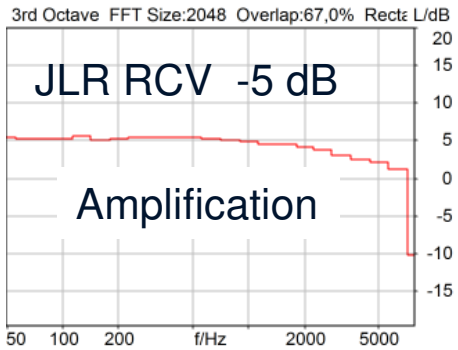
Uplink

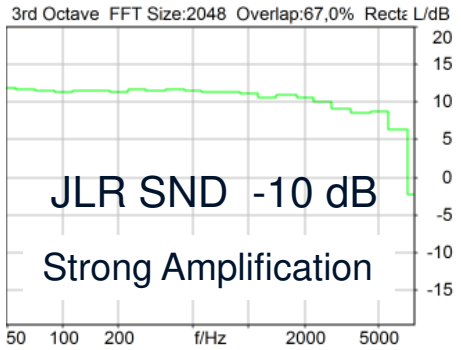
Downlink

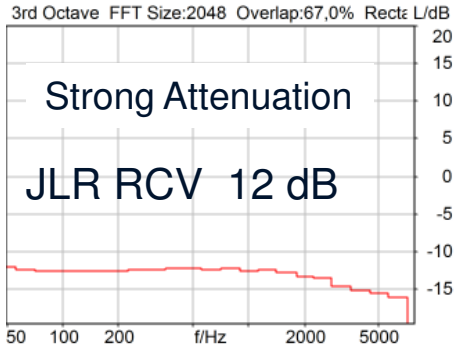












⟹ Ideal behaviour: Transparent transmission to and from the car HFT

⟹ Risk for signal saturation / signal compression

⟹ Strong signal saturation / compression in uplink HFT Volume control range in downlink compromised (downlink)

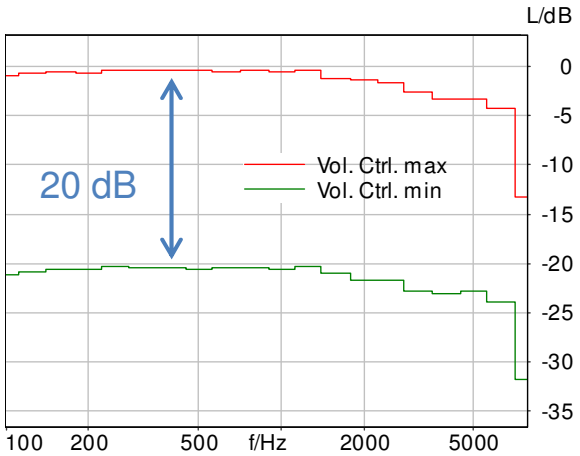
Remote Audio Volume Ctrl. (RAVC) and Phone Volume Ctrl.

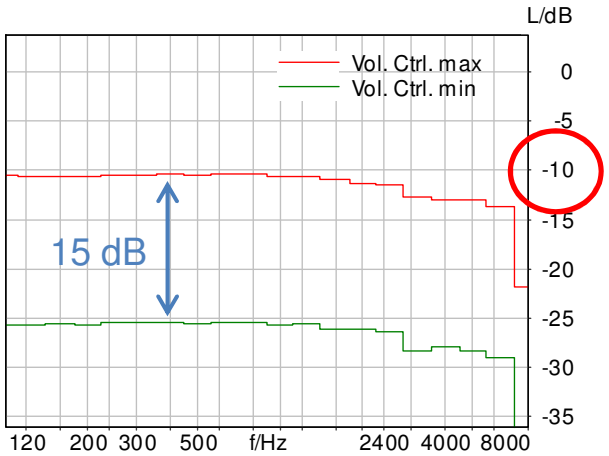
What is RAVC?

Remote control of the HFTs audio gains via dedicated AT commands from phone

(Optional Feature)

Some phones keep their own volume control active and apply strong attenuation in downlink to the audio path (apparently to support older Bluetooth® accessories w/o integrated volume control)





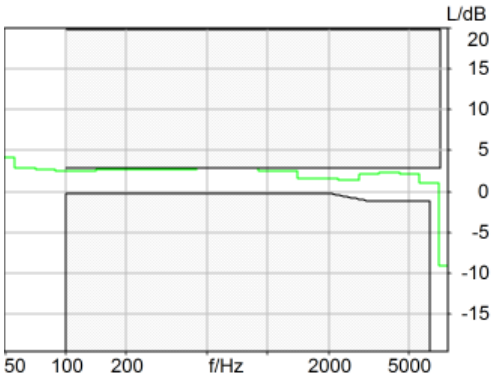
→ Strong impact on car HFT:

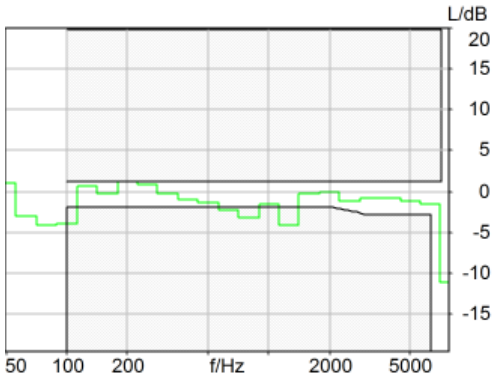
- playback volume for comfortable signal-to-noise ratio under driving conditions may not be sufficient
- The user may be incited to adjust volume control on the phone (safety issue!)

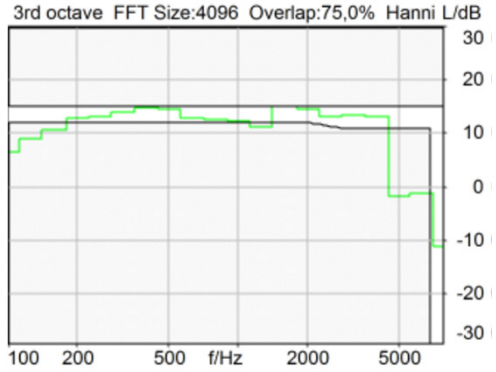
Equalizing

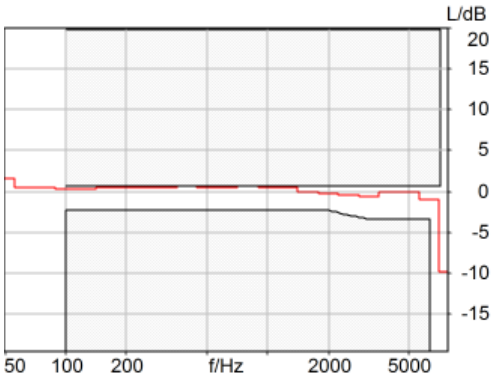
Ideal behaviour:
Spectral shape of speech
to and from the car HFT
practically not modified

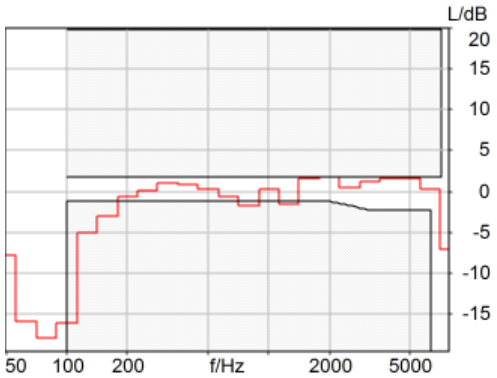
Equalizing filter active:
Spectral shape of speech
to and from the
car HFT modified

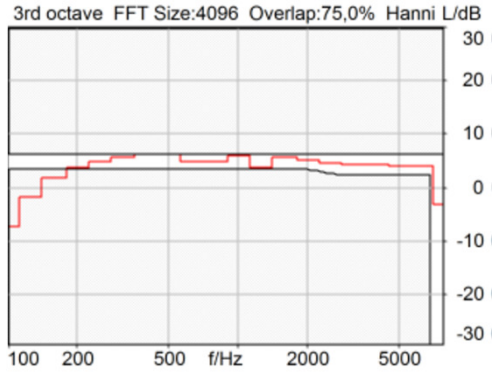












Conclusions & Outlook

- Non-transparent phones are still an issue in automotive industry
  → Tuning effort (!!), performance, customer complaints…
- ITU-T Test Events initiated by automotive industry and suppliers
- Test Events adress audio performance of mobile phones
  → Help phone manufactures to detect it and improve quality
  → Feedback into the standardization process (ITU SG 12)
- ITU-T “Whitelist“ provides transparency for car maker and customers
  http://www.itu.int/en/ITU-T/C-I/Pages/HFT-mobile-tests/HFT_testing.aspx
- New requirements and clarifications from SG12 Meeting (01/2017) to be considered in upcoming Test Events/Tests