TERACOM

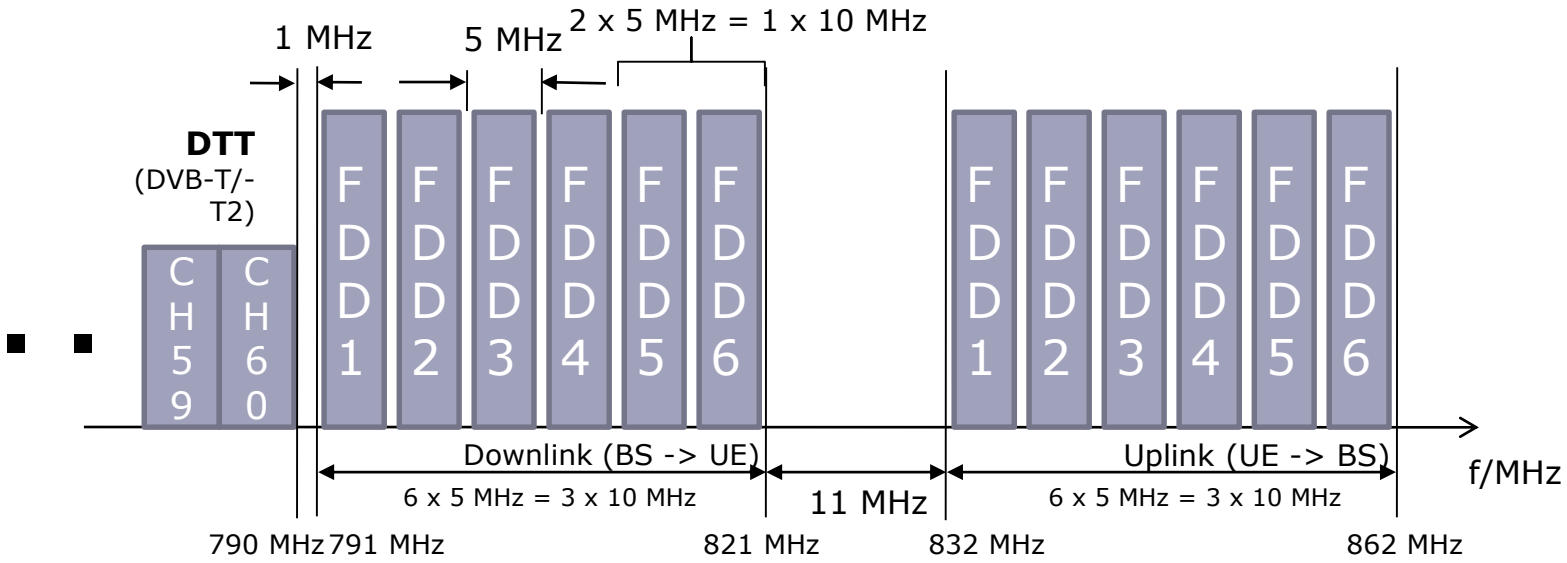
LTE700 and LTE800 MHz requirement proposal

2016-04-26

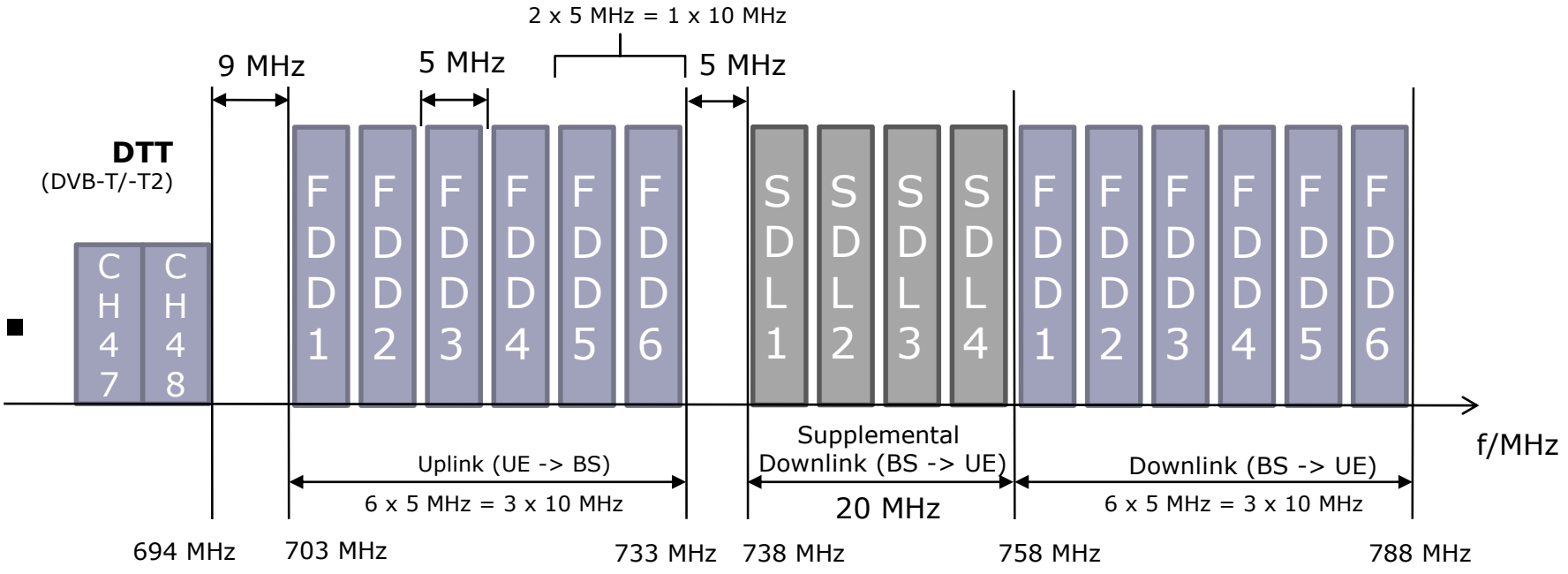
Background (LTE700 MHz)

- Some countries will re-allocate 700MHz TV broadcast frequencies for mobile telephone network use
- Decision is taken by national administration. E.g. In Finland and Sweden re-allocation will be on effect during 2017
- It is expected that mobile telephone network operators will use the LTE technology for 4G mobile telephone systems on this frequency range like it happened on 800 MHz frequencies
- The downlink of the base station (BS) and user equipment (UE) uplink frequency occupation is different compared to LTE800MHz.

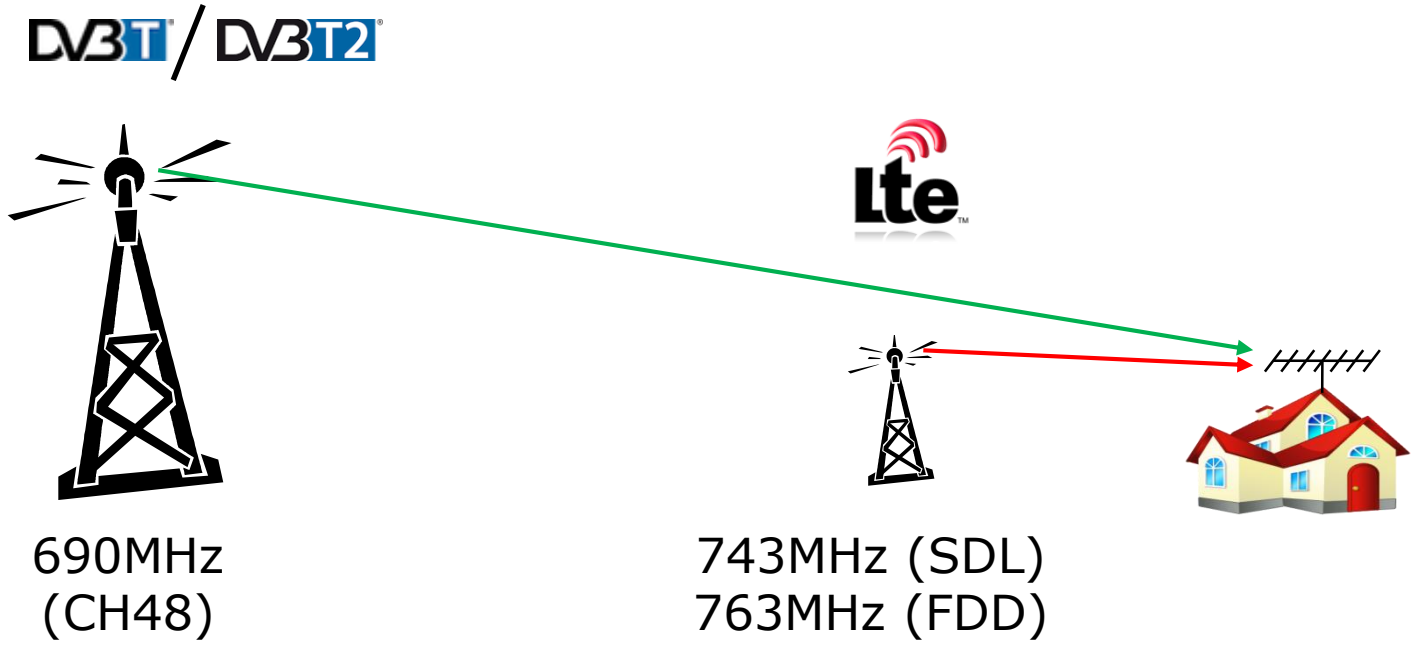
LTE800 MHz freq occupation recapture



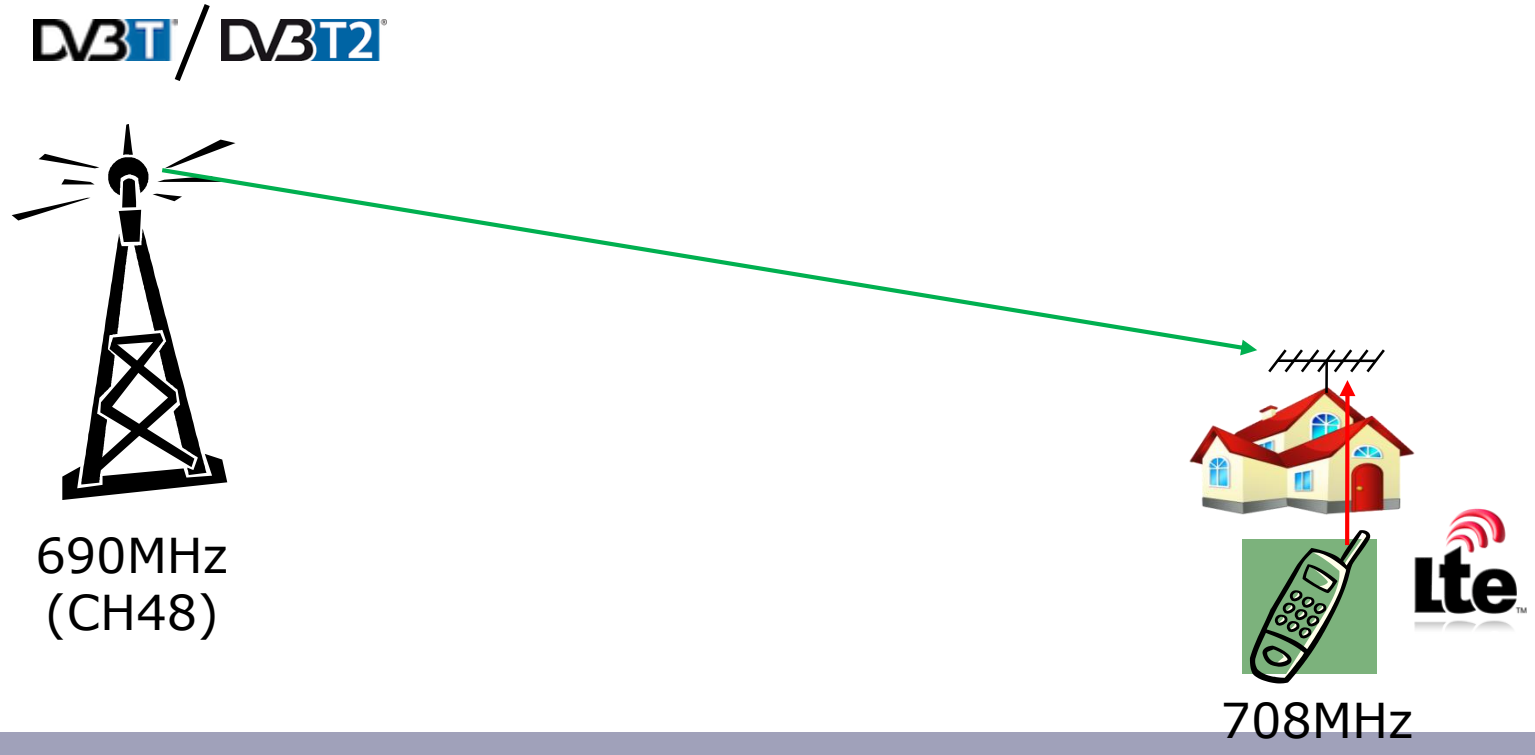
LTE700 MHz frequency allocation



Worst case from Basestation



Worst case scenario from User Equipment



Work done so far…

- As a part of the CE marking European Union has replaced the Radio & Telecommunication Terminal Equipment Directive 1999/5/EC (RTTED) with The Radio Equipment Directive 2014/53/EU (RED). It will be in effect 13 June 2016.
- One of the changes is that TV receivers will be included
- Directive presumes there exists a harmonised standard which is the base for fullfilling the directive
- Requirements in standard are based on current receiver performance verified through measurements for implementation on 700MHz
- ”Limitations” of the standard are:
  - Only receiver performance defined, i.e. no antennas/preamplifiers
  - Only roof-top reception use case covered
  - Requirement only for first adjacent channel interference
  - Fullfilling the requirement is linked to certain type of LTE signal charasteristics
  - Only restricted number of DVB-T and DVB-T2 broadcast mode parameter settings included

Therefore …

- Proposal to NorDig is to cover more
- Proposal for the requirement is more generic (as it is for LTE800MHz)
  - All allocated on-air frequencies for terrestrial broadcasts frequencies are included
  - Requirement is independent of the LTE characteristic (however, test plan defines the LTE signal characteristics)
  - Indoor reception using passive antenna ”included”

LTE700MHz I/C requirement proposal

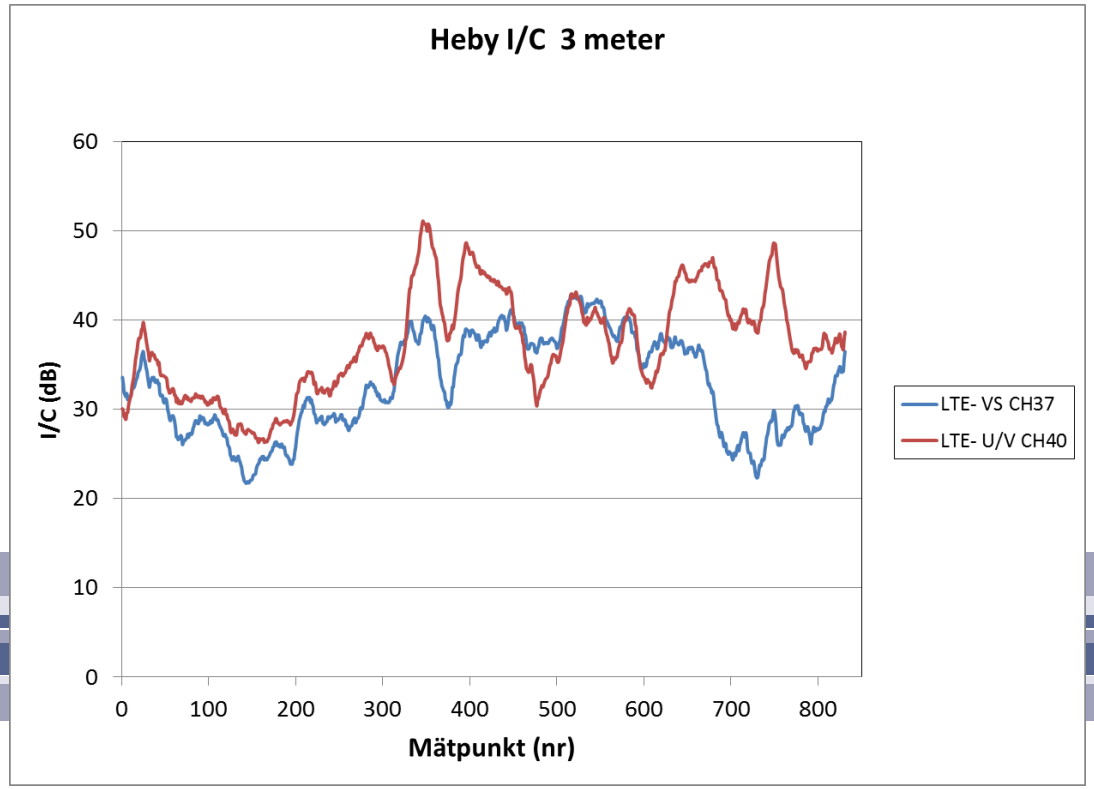
Band	Channel	DVB-T or DVB-T2 System	Signal Bandwidth and Channel frequency raster (MHz)	Minimum I/C (dB) for NorDig IRDs that are launched before 1 July 2017.			Minimum I/C (dB) for NorDig IRDs that are launched after 1 July 2017.		
				10 MHz Uplink, (FDD1&2)	10 MHz Uplink (FDD3&4, FDD5&6)	10 MHz Downlink (FDD1&2, FDD3&4, FDD5&6, SDL1&2, SDL3&4)	10 MHz Uplink, (FDD1&2)	10 MHz Uplink (FDD3&4, FDD5&6)	10 MHz Downlink (FDD1&2, FDD3&4, FDD5&6, SDL1&2, SDL3&4)
VHF III,	K5-K12	DVB-T	7	46	46	46	50	50	50
UHF IV,	K21-K37	DVB-T	8	46	46	46	50	50	50
UHF V,	K38-K47	DVB-T	8	43	43	46	46	46	50
UHF V,	K48	DVB-T	8	33	43	46	43	46	50
VHF III,	K5-K12	DVB-T2	7	46	46	46	50	50	50
UHF IV,	K21-K37	DVB-T2	8	46	46	46	50	50	50
UHF V,	K38-K47	DVB-T2	8	43	43	46	46	46	50
UHF V,	K48	DVB-T2	8	38	43	46	43	46	50

{FFT=8K, M=64-QAM, CR=2/3, GI =1/8, B=8MHz},
{FFT=8K, M=64-QAM, CR=2/3, GI =1/4, B=8MHz} and
{FFT=8K, M=64-QAM, CR=3/4, GI =1/4, B=8MHz}
{FFT=32KE, M=256-QAM R, PP=4, CR=2/3, GI =1/16, 8MHz},
{FFT=32KE, M=256-QAM R, PP=4, CR=3/5, GI =19/256, 8MHz},
{FFT=32KN, M=256-QAM R, PP=4, CR=2/3, GI =19/256, 7MHz} and

Interfering licensed power level signal level is in the range of -15 to -25 dBm at the input of the IRD

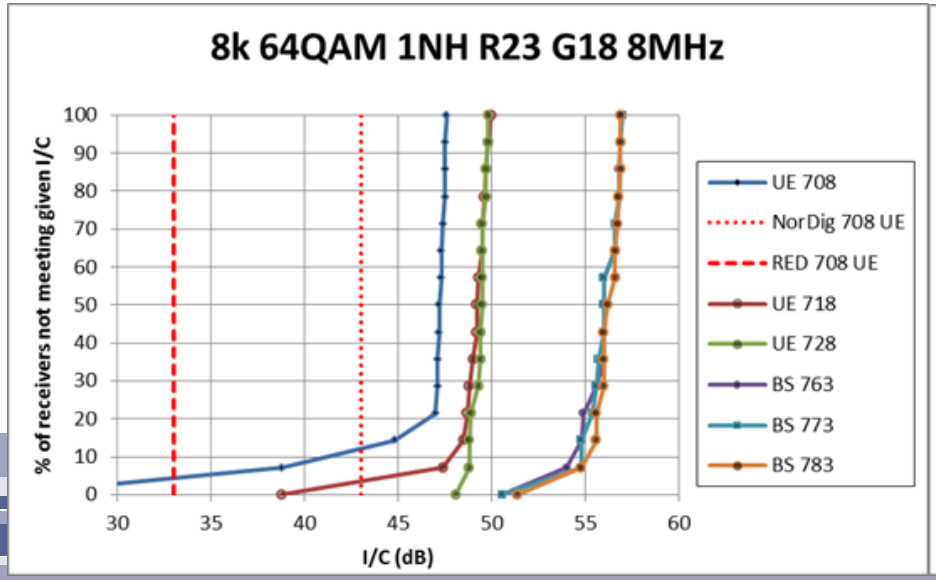
Why higher I/C requirement?

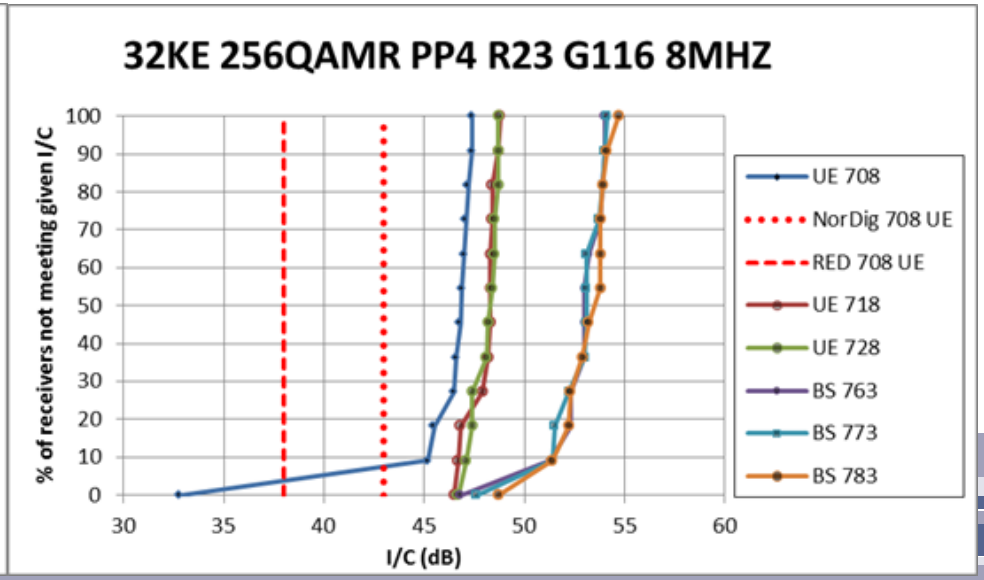
- LTE signal levels are HIGH on the field
- E.g. on 3m antenna height field measurement performed by Teracom on a random selected measurement route on 800MHz DVB-T signals compared to LTE has I/C up to 50dB!



Tests and test plan for LTE700

- New requirement needs a new test procedure in NorDig Test Plan.
- Preliminary tests according to harmonised standard against proposed NorDig requirement (I=-25dBm) show it is not difficult to fullfill the NorDig requirement
- Figures below show the proposed requirement in red dotted lines ”now” and after 1st July 2017 for the closest interferer on frequency domain.





Tests and test plan for LTE700

- Test procedure proposal for DVB-T and DVB-T2 is available

The LTE transmission is generated by using following LTE signal characteristics:
BS 0% traffic load (LTE_BS-idle_V3_synth.wv)
UE Video stream traffic (short_UE-Video-Stream_V2.wv)

Files in I/Q file format specified above are available on NorDig homepage.

Test procedure:

1. Set up the test instruments
2. Use the following DVB-T2 mode {8K, 64-QAM, R=2/3, Δ/Tu =1/8, 8MHz }
3. Set the channel A up-converter to 690.0MHz (K48).
4. Set the channel B up-converter to 708.0MHz .
5. Set the LTE interefer to UE Video traffic traffic mode.
6. Set the receiver input level for the LTE signal in channel B to -25 dBm.
7. Decrease the wanted signal level in channel A to a signal level when the quality measurement procedure 2 is still fulfilled.
8. Fill in the measured signal level difference between channel A and channel B signals in dB in measurement record.
9. Repeat the test when the channel B up-converter is set to frequencies 718.0 MHz, 728.0 MHz.
10. Set the channel B up-converter to 763.0MHz.
11. Set the LTE interefer to BS 0% traffic load mode.
12. Set the receiver input level for the LTE signal in channel B to -15 dBm.
13. Decrease the wanted signal level in channel A to a signal level when the quality measurement procedure 2 is still fulfilled.
14. Fill in the measured signal level difference between channel A and channel B signals in dB in measurement record.
15. Repeat the test when the channel B up-converter is set to frequencies 773.0 MHz, 783.0 MHz.
16. Repeat the test for the DVB-T mode {8K,64-QAM,R=3/4,Δ/Tu =1/4,8MHz}.

Expected result:

LTE800MHz I/C requirement proposal

- To update current requirement to sligthly stringent and remove least robust transmission parameter setting more

Band	DVB-T/ DVB-T2 channel	Signal Bandwidth and Channel frequency raster (MHz)	~~Channel frequency raster (MHz)~~	Minimum I/C (dB) for NorDig IRDs that are launched before 1 July 2017.			Minimum I/C (dB) for NorDig IRDs that are launched after 1 July 2017.		
				10 MHz Downlink, (FDD1&2)	10 MHz Downlink (FDD3&4, FDD5&6)	10 MHz Uplink (FDD1&2, FDD3&4, FDD5&6)	10 MHz Downlink (FDD1&2)	10 MHz Downlink (FDD3&4, FDD5&6)	10 MHz Uplink (FDD1&2, FDD3&4, FDD5&6)
VHF III	K5-K12	7	~~7~~	~~40~~ 44	~~40~~ 44	~~40~~ 44	48	48	48
UHF IV	K21-K37	8	~~8~~	~~40~~ 44	~~40~~ 44	~~40~~ 44	48	48	48
UHF V	K38-K59	8	~~8~~	~~40~~ 41	~~40~~ 41	~~40~~ 44	45	45	48
UHF V	K60	8	~~8~~	~~30~~ 36	~~40~~ 41	~~40~~ 44	40	45	48

LTE800 MHz tests

- Current test results show that the new proposal is not difficult to fullfill (I=-15dBm)
- Figures below show the new proposed requirement in red dotted line ”now” and after 1st July 2017 for the closest interferer on frequency domain.