

3GPP TSG-RAN WG4 Meeting #82Bis  
Spokane, Washington, USA, 3-7 April 2017

R4-1703837



# EXPERIENCE AND LEARNINGS FROM MULTI- NODE COEXISTENCE TESTS

Ericsson

# SUMMARY



- › 6 Weeks test duration (with on-site engineers + remote support)
- › Unable to pre-execute WFA tests before going to the ATL
- › Huge variation in Wi-Fi test equipment behavior
- › Test complexity makes reproducibility in different labs practically impossible
  
- › Ericsson EUT executed & passed ALL applicable tests

# TEST EXECUTION PREP & LOGISTICS



- › Test Duration: Dec 19 – Jan 30. Total of 6 weeks testing duration
- › ATL lab prepared before Ericsson arrived on site
  - Wi-Fi – Wi-Fi baseline tests had not been 100% completed by test start date.
- › Ericsson EUTs (2) shipped to site ahead of test start date.
  - Antenna connectors manually added in place of EUTs internal antennas (Murata connector + cable loss of 2-3.5dB)
- › Additional equipment: simulated 3GPP packet core network PCs and test UEs, SIM cards
- › At least one Ericsson engineer on site for the entire duration of the test activity.
- › Excellent support from the ATL test lab team. Willing to work many extra hours and weekends.

| January |    |    |    |    |    |    |
|---------|----|----|----|----|----|----|
|         |    |    |    | 1  | 2  | 3  |
| 4       | 5  | 6  | 7  | 8  | 9  | 10 |
| 11      | 12 | 13 | 14 | 15 | 16 | 17 |
| 18      | 19 | 20 | 21 | 22 | 23 | 24 |
| 25      | 26 | 27 | 28 | 29 | 30 | 31 |

# THE PRACTICALITIES



1. Lots of “moving parts” – debugging equipment, IP/Eth network, signal levels, measurement equipment, scripts, etc.
  - Due to the complexity the lab is very fragile – making reproducibility challenging (between labs and also between runs on same lab)
  - Small changes (such as changing a cable connector or the length of a ‘pause’ in a test script) can make a significant difference from one run to another.
2. Unable to pre-test equipment:
  - Required specific Wi-Fi test equipment (with special SW loads) and test scripts
  - No baseline data available (i.e. no pass/fail criteria for many tests until after the tests were executed)
  - Test scripts and tests very sensitive to the exact test & measurement equipment used
3. Many thousands of individual tests –
  - For example one particular test: 20 mins per test run x 6 combinations x 3 test levels x enough runs to get good statistical results
  - 360 x 30 test runs = 180 hours or 7 ½ days (at 24/7)
  - What is practical but still reasonable (given variability in baseline results)?
4. Automated scripts required in order to execute tests 24x7
  - However, if something unexpected happened during a test run the testing would stop and it would not be caught until the logs were manually analyzed the following day.

# OBSERVATIONS



1. No standard way to measure received energy (RSSI) across Wi-Fi vendors
  - Different vendors equipment give different results
  - We have seen 6dB variations (test results previously presented to WFA CoX)
2. Measurement accuracy margin ( $\pm 4$ dB) is large
  - Same device is sometimes above PD and sometime below during a test
  - Different devices in the same test are above and below threshold
3. Unpredictable behaviour of Wi-Fi equipment at signal levels close to ED & PD
  - Wi-Fi baseline One-Way-Delay sample STDEV result @ -50dBm = 7.72. @ -82dBm = 735.9

# OBSERVATIONS (2)



1. Wi-Fi equipment behaves differently to other co-channel Wi-Fi equipment compared to non-Wi-Fi equipment:
    - Many Wi-Fi devices adjust their ED/PD thresholds based on interference/noise measurements
    - Interference measurements are different if the interferer is Wi-Fi vs. non-Wi-Fi
    - Proprietary, vendor specific “features” → unpredictable results, exasperated by test setup
  
  2. Wi-Fi backs off to other Wi-Fi at a different energy level compared to LTE-U
    - E.g. Below -62dBm, Wi-Fi systems provide coexistence protection to another Wi-Fi system, however Wi-Fi continues to transmit even if another *non* Wi-Fi transmitter is present.
- › Pass/Fail criteria essentially penalizes LTE-U because it’s not applied to Wi-Fi



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