

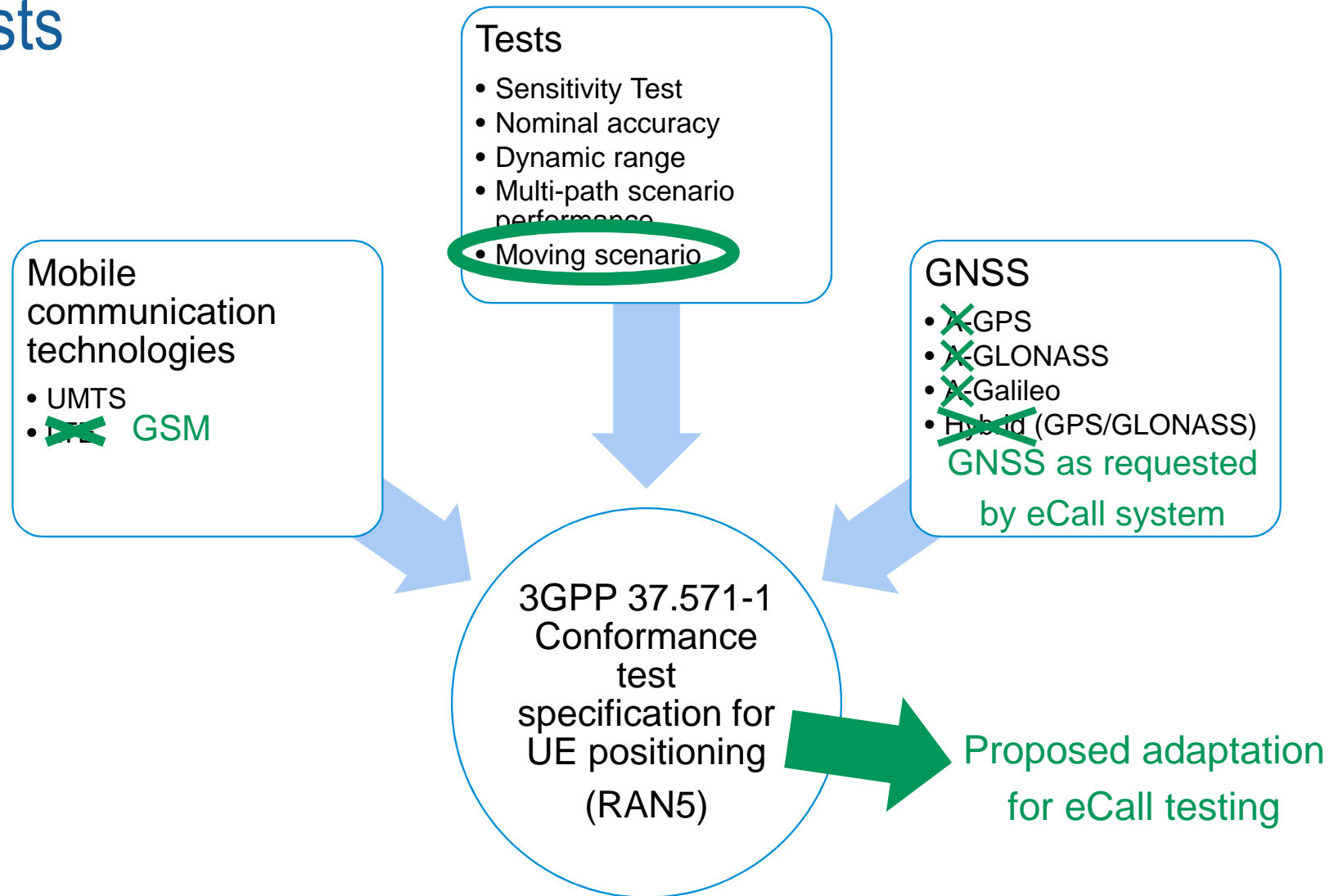
# GNSS Performance - Conformance Tests according to 3GPP TS 37.571-1 with proposed adaptation for eCall

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# Existing GNSS Tests as a Basis for eCall Positioning Tests



# General test conditions TS 37.571-1 – Part 1

- GNSS signals transmitted with a frequency accuracy of  $\pm 0.025$  PPM
  - Static: AWGN, no fading, no multi-paths (clause 4.2.3)
  - Multi-path conditions (clause 4.2.4)
  - Multiple satellite signals (clause 4.2.5)
  - Multi system time offsets when using hybrid mode time offset between systems  $< 3$  ns (clause 4.2.6) → not applicable for eCall scenario (no hybrid mode)
  - Minimum performance requirements for both
    - UE based A-GNSS terminals (measurement parameters are contained in the RRC UE POSITIONING POSITION ESTIMATE INFO IE)
    - UE assisted A-GNSS terminals (measurement parameters are contained in the RRC UE POSITIONING GANSS MEASURED RESULTS IE and/or the RRC UE POSITIONING GPS MEASURED RESULTS IE)
- no assisted data for eCall scenario, transmission of assisted data has to be skipped, a trigger for the eCall modem to send the acquired positioning data has to be introduced (manual or automatic eCall event)

PPM – Parts Per Million

AWGN – Additive White Gaussian Noise



# General test conditions TS 37.571-1 – Part 2

- 2D position error: defined by the horizontal difference in meters between the ellipsoid point reported or calculated from the UE Measurement Report and the actual simulated position of the UE in the test case considered.
- no stored GNSS data shall be used → for eCall the last three stored positions are applicable and have to be transmitted in the MSD upon eCall activation (manual or automatic eCall event)
- No additional sensor data as positioning aid → could be helpful for eCall as such but the minimum performance of the GPS receiver shall be tested. Hence the same criteria applies for eCall.



# 3GPP TS 37.571-5 V10.8.0, clause 5.2.6.4

Scenario	GPS #1	GPS #2	GPS #3 (Moving)
City	Atlanta, USA	Melbourne, Australia	Melbourne, Australia
Degrees of latitude	33.750005	37.816663	37.816663
Degrees of longitude	-84.383336	144.966670	144.966670
Altitude in m	300	100	100
Uncertainty semi-major in m	3000	3000	3000
Uncertainty semi-minor in m	3000	3000	3000
Uncertainty altitude in m	500	500	500

→ reference coordinate adaptation for eCall:  
choose European city or rural area,  
add highway scenario (moving)



# Sensitivity Tests (3GPP TS 37.571-1, clause 5.2)

- Two subtests of satellite setup (minimum signal level)

Coarse time assistance	Fine time assistance
1 GPS = -142.0 dBm 7 GPS = -147.0 dBm	8 GPS = -147.0 dBm

- Two scenarios used alternatingly
  - GPS #1 (Atlanta, USA)
  - GPS #2 (Melbourne, Australia)

- Minimum requirements

Success rate	2-D position error	Max response time
95 %	100 m	20 s



# Nominal Accuracy (3GPP TS 37.571-1, clause 5.3)

- Satellite setup (ideal signal conditions)

**Same signal level of all satellites**

8 GPS = -130.0 dBm

- Two scenarios used alternatingly
  - GPS #1 (Atlanta, USA)
  - GPS #2 (Melbourne, Australia)

- Minimum requirements

Success rate	2-D position error	Max response time
95 %	30 m	20 s



# Dynamic Range (3GPP TS 37.571-1, clause 5.4)

- Satellite setup (maximum signal level difference)

## Different signal levels of the satellites

1 GPS = -129.0 dBm

1 GPS = -135.0 dBm

1 GPS = -141.0 dBm

3 GPS = -147.0 dBm

- Two scenarios used alternatingly
  - GPS #1 (Atlanta, USA)
  - GPS #2 (Melbourne, Australia)

- Minimum requirements

Success rate	2-D position error	Max response time
95 %	100 m	20 s





# Multi-path Perform. (3GPP TS 37.571-1, clause 5.5)

- Satellite setup (multi-path environment)

## Different signal levels of the satellites

2 GPS = -130.0 dBm	no multi-path
3 GPS = -130.0 dBm LOS	faded = -136.0 dBm 2nd tap

- Two scenarios used alternatingly

- GPS #1 (Atlanta, USA)
- GPS #2 (Melbourne, Australia)

- Minimum requirements

Success rate	2-D position error	Max response time
95 %	100 m	20 s



# Moving Scenario (3GPP TS 37.571-1, clause 5.6)

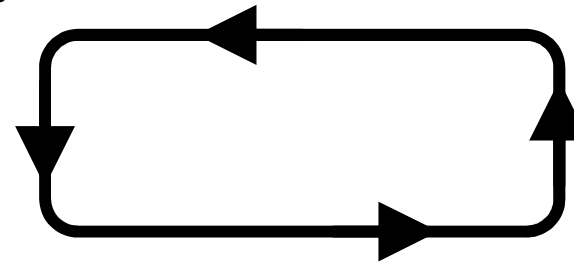
- Satellite setup (good signal level)

**Same signal level of all satellites**

5 GPS = -130.0 dBm

- Scenario GPS #3 (Melbourne, Australia)

- Moving scenario on a rectangular trajectory, UE within a vehicle that accelerates, slows down and turns
- Vehicle speed: 25 to 100 km/h



- Minimum requirements

Success rate	2-D position error	Reporting interval
95 %	100 m	1.5 s to 2.5 s



# Summary of proposed adaptations for eCall

Conformance tests in 3GPP TS 37.571-1 can be used as a basis for eCall GNSS performance testing.

Proposed changes for eCall:

No assisted data, only GPS

Manual or automatic GSM / UMTS eCall as a trigger

Last three positions sent within the MSD

Reference coordinates within Europe (city, rural area)

Appropriate position error and response time

Test time from IVS modem start / after re-gaining GPS reception

Emphasis on moving scenario

Add highway scenario, record and replay scenario

Optional?

