R1-145120
Proposal on Test Vector Methodology for Indoor Positioning Study Item

November 7, 2014

Agreement from RAN1#78bis

- For evaluating baseline performance, two scenarios are defined for the existing positioning techniques (e.g. A-GNSS, E-CID, OTDOA, UTDOA, or hybrids thereof) for indoor environments:
  - Outdoor deployment scenario, at least for the case of macro + outdoor small cell only
    - FFS: whether or not to evaluate the case of Macro only deployment
  - Outdoor macro + indoor small cell deployment scenario
- The above scenarios are also applicable to evaluate physical layer design options, enhanced measurements, and/or any additional impacts or enhancements, as applicable per technology, for RAT-dependent and RAT-independent positioning systems, including suitable frequencies and signals.

Motivation

- WF agreement enumerates multiplicity of positioning techniques for evaluations, with existing and enhanced variants, under a variety of use case scenarios.
- Positioning techniques of various types mentioned, including RAT-dependent and RAT-independent.
- Concern expressed by some participants regarding scale of effort, the potential impact on simulation load, resources and meeting time.
- Thus it is imperative a study methodology be identified that scales to the multiplicity of evaluations, while also allowing for a timely progress on the SI.
- Simulations of one positioning technique cannot be used to draw conclusions on some other positioning techniques.
- At the same time, requiring all participants to assess all positioning techniques can become prohibitive.

Proposed Simulation Methodology

- A methodology is proposed that validates and calibrates simulations at the component-level, in a modular manner.
- It is proposed that submissions for a given positioning technology, scenario, etc. (aka “evaluation”) meet some agreed level of “conformance” established for that evaluation.
- Simulation conformance is defined as the ability of that evaluation to pass the test vector suite established for that evaluation.
- Test vectors for an evaluation are defined based on the simulation components that are relevant to that evaluation.
- Test vector suites for evaluations on the positioning study item may consist, for example, of test vectors on the wireless channel model, node placement and position computation engine.
- Similar methodology was used for system level simulator calibration in LTE-Advanced evaluations (see A.2.2 of TR 36.814).

Rationale for Use of Test Vectors

- Test vector methodology enables alignment of simulations and assessment of simulation results and conclusions for a broad range of technologies and system model assumptions.

- Test vector methodology allows for calibration of positioning technologies that are RAN-dependent and RAN-independent.

- Facilitates convergence on and understanding of simulation results by all participants, even with regards to positioning techniques that are not of direct interest or simulated by a given participant.

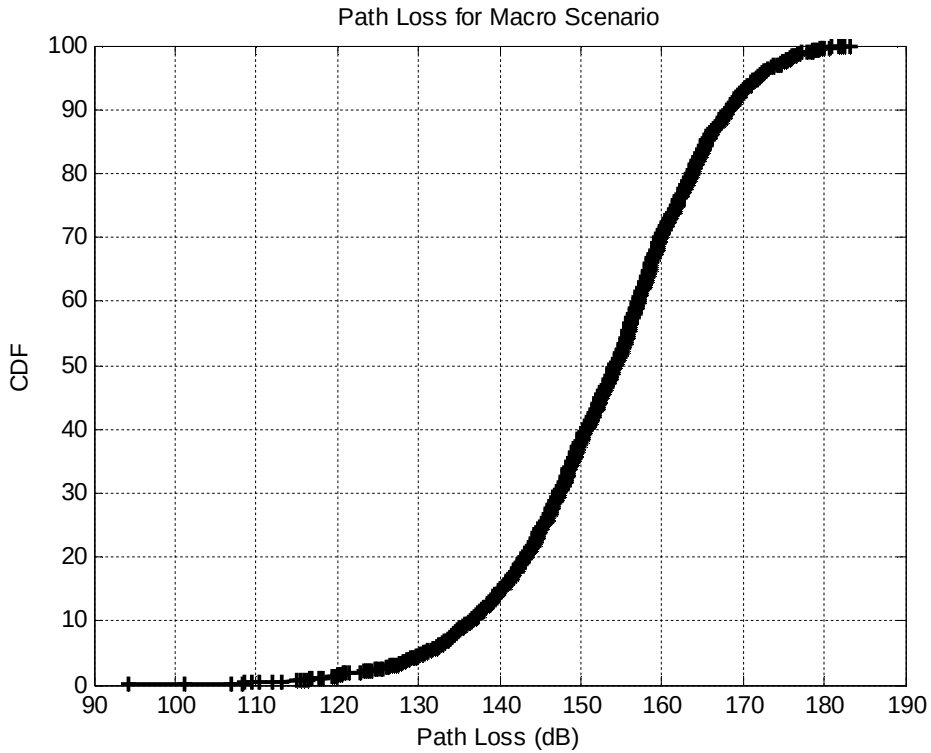
- Testing of individual simulation components allows for increased confidence in simulation results and can expedite group-level decisions.

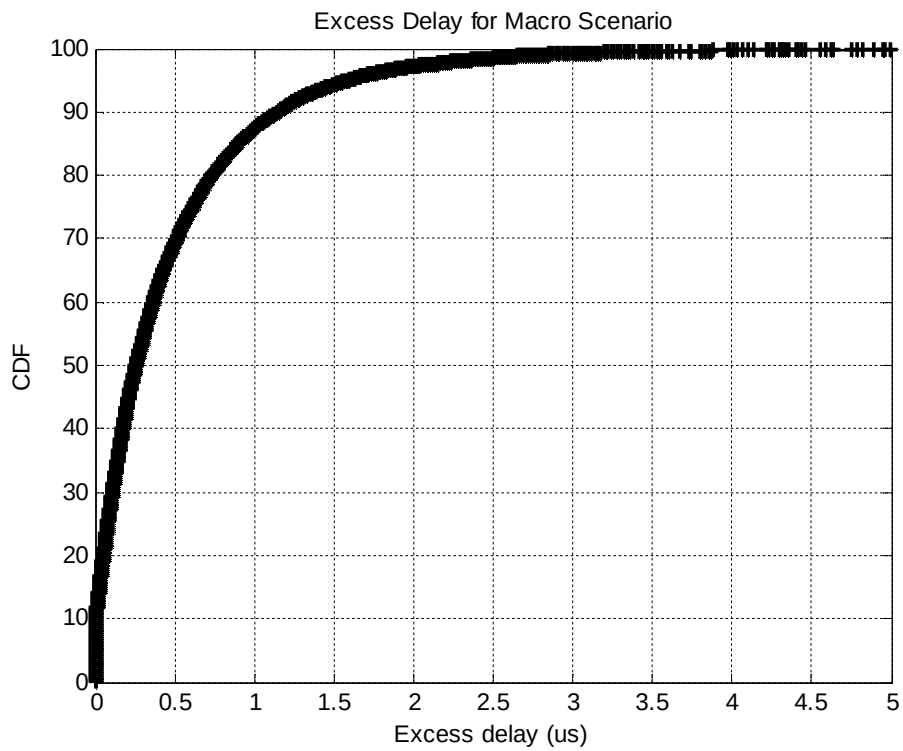
Test Vector Considerations

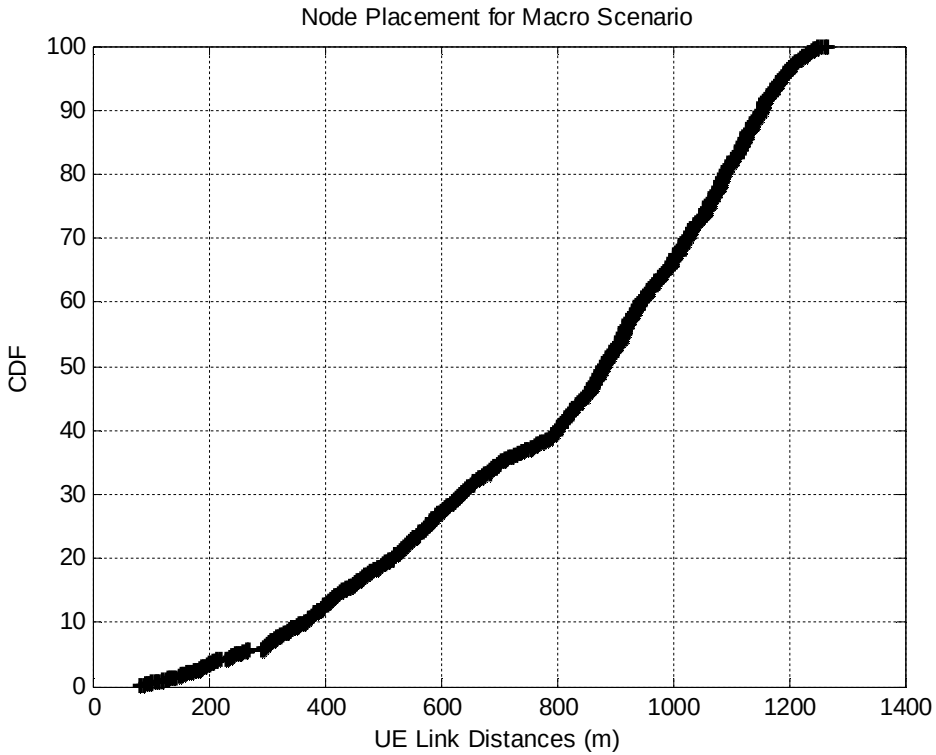
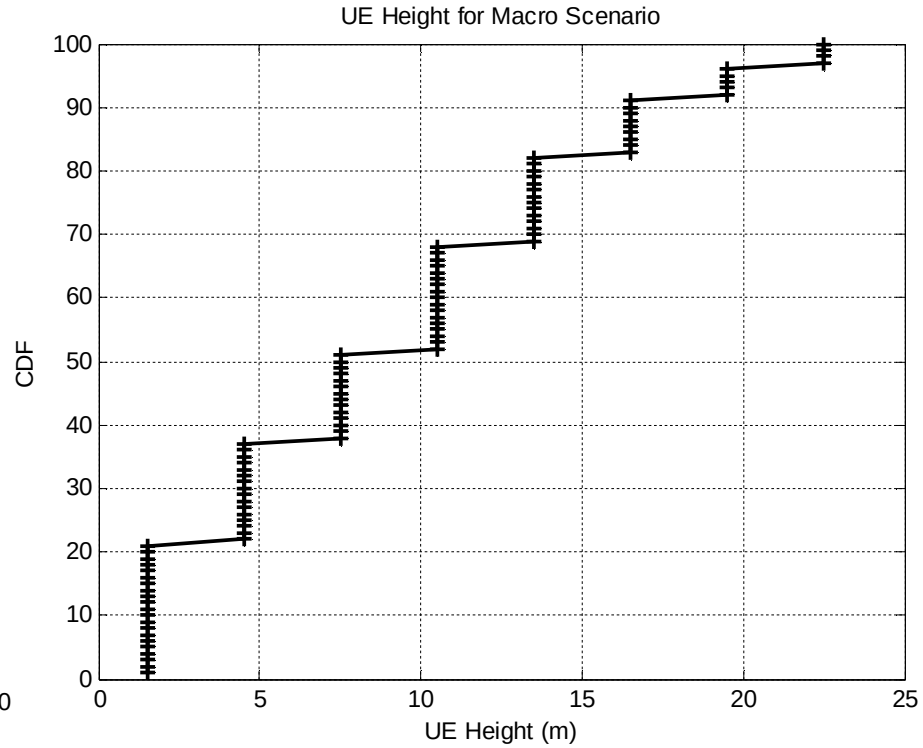
- A number of test vectors are relevant to evaluations in this SI, including for the wireless channel model, node placement and position computation engine.
- Suggestions for test vectors on the wireless channel model include:
  - Statistics of path delays and powers for a given multipath model and network/user scenarios
  - Statistics of path-loss for a given wireless model and network/user scenarios
  - Examples based on references R1-143844, R1-143845 included in following slides
- Suggestions for test vectors on node placement include:
  - Statistics of distributions on inter-node distances
  - Statistics of distributions on UE placement (e.g. in-building height and depth)
  - Examples based on references R1-143844, R1-143845 included in following slides
- Suggestions on test vectors for the position computation engine include:
  - Statistics of position errors as a function of measurement errors and DOP aspects
  - FFS (further discussions on position computation)

Channel Model Validation

- Example CDFs of path loss and multipath profile corresponding to the macro scenario.
- Test vector suite may consist of statistics such as median, 1-sigma, may account for averaging and spread across simulators as needed, etc.
- Assumptions: Fc=2GHz, ISD=500m, 19 cells in hexagonal grid with wraparound
- References: R1-143844, R1-143845





Node Placement Validation

- Example CDFs of relative node placement and UE heights for macro scenario.
- Test vector suite may consist of statistics such as median, 1-sigma, may account for averaging and spread across simulators as needed, etc.
- Assumptions: ISD=500m, 19 cells in hexagonal grid with wrap-around
- References: R1-143844, R1-143845