Methodology for Employing Variable Attenuators in a Conducted Test Environment

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Abstract

This presentation is in support of draft text in IEEE 802.11-05/0702r2.

The draft text for the recommended practice follows the approved template as outlined in 802.11-05/1641r01, “Metrics Template Example”.

Employing variable attenuators in a conducted test environment is one methodology for measuring various metrics and sub-metrics. As the the speed by which the imposed attenuation is changed has an effect on reported results, this document provides a methodology for employing variable attenuators in a conducted test environment. The purpose of this document is to define a procedure that will result in repeatable, reliable, and comparable results. This methodology shall be applied for tests using a conducted environment whenever the attenuation of the communication channel is varied while measuring metrics and sub-metrics.

Motivation

- Some metrics and sub-metrics discussed by TGt require changing the attenuation imposed on the communication test signal during the test if a conducted test environment is used. E.g.:
  - Rate vs. Range [1]
  - BSS Transition Time [2]

- The speed at which the imposed attenuation is changed does have an influence on the reported results for certain metrics. [3,4]

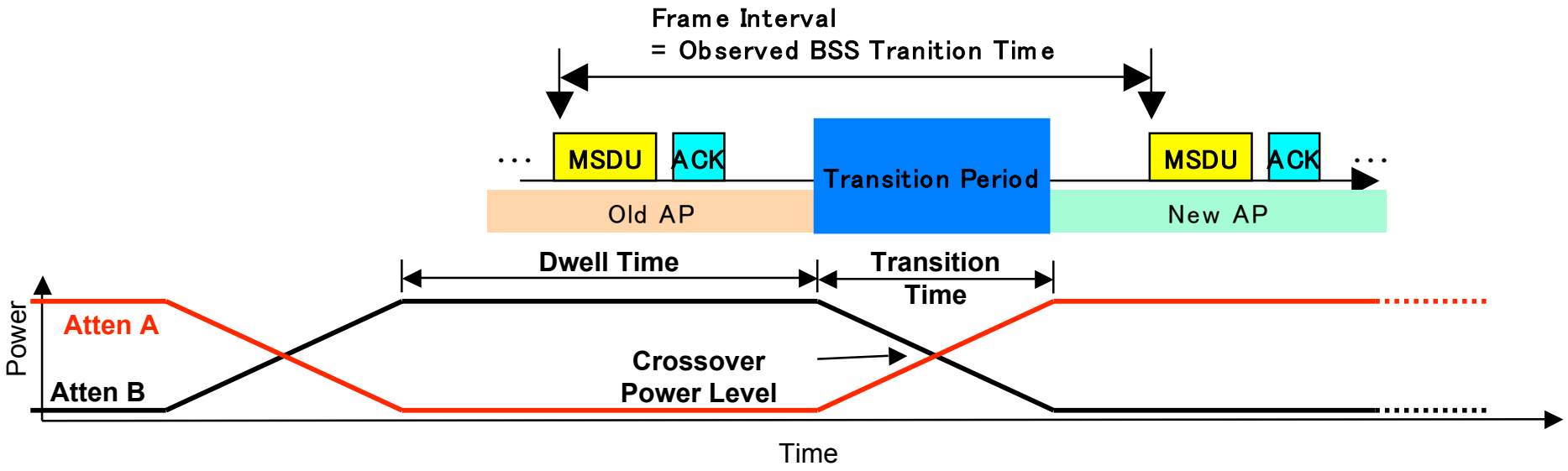
- The objective of TGT is to come up with a *repeatable* measurement methodology ensuring that reported results are comparable.

Thus, **a methodology for using variable attenuators in a conducted test environment is required** to achieve TGt's objective to guarantee high repeatability of test results (over-time and location).

Where this Methodology does apply

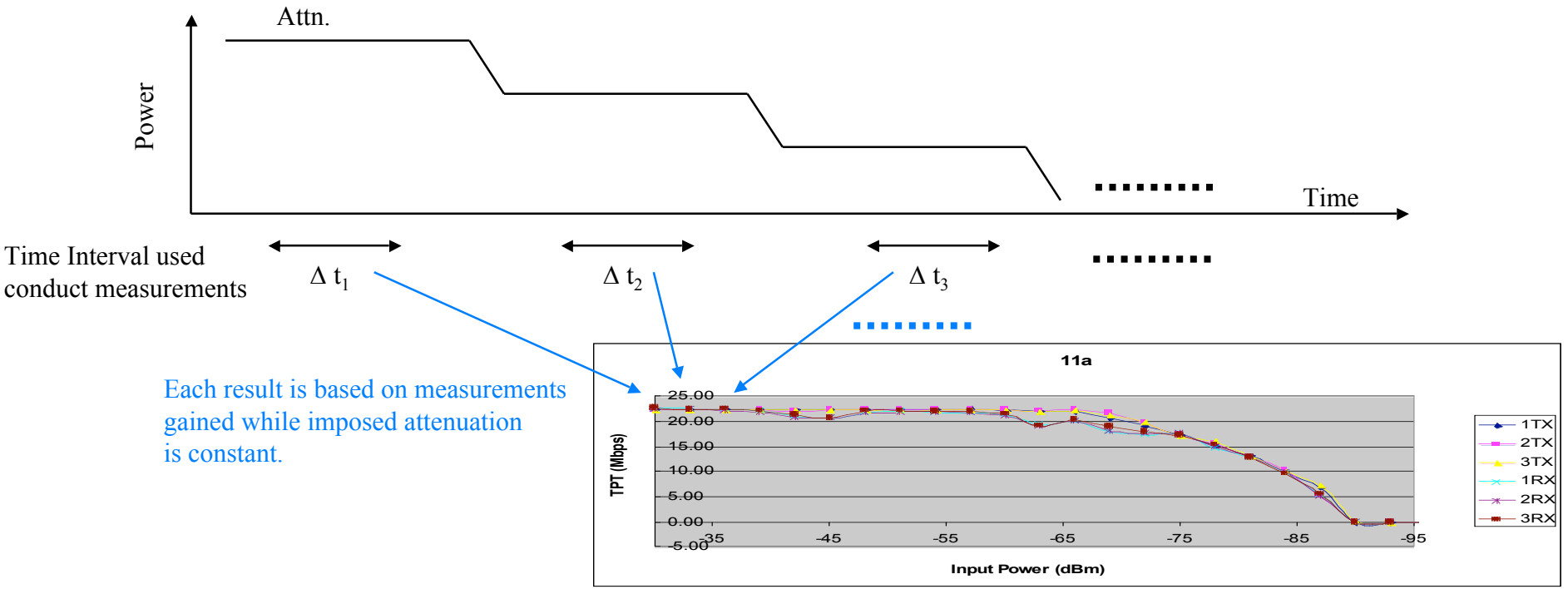
- **Obey this methodology whenever the *attenuation* imposed on the communication test signal *is changed while measurements are being taken***

- **<u>Example</u>: BSS Transition time [2,6]**



Where this Methodology does *not* apply

- **Not applicable if attenuation is kept constant while metric / sub-metric is measured**
- **Example: Rate vs. Range / Attenuation [1,7,8]**



Clarification

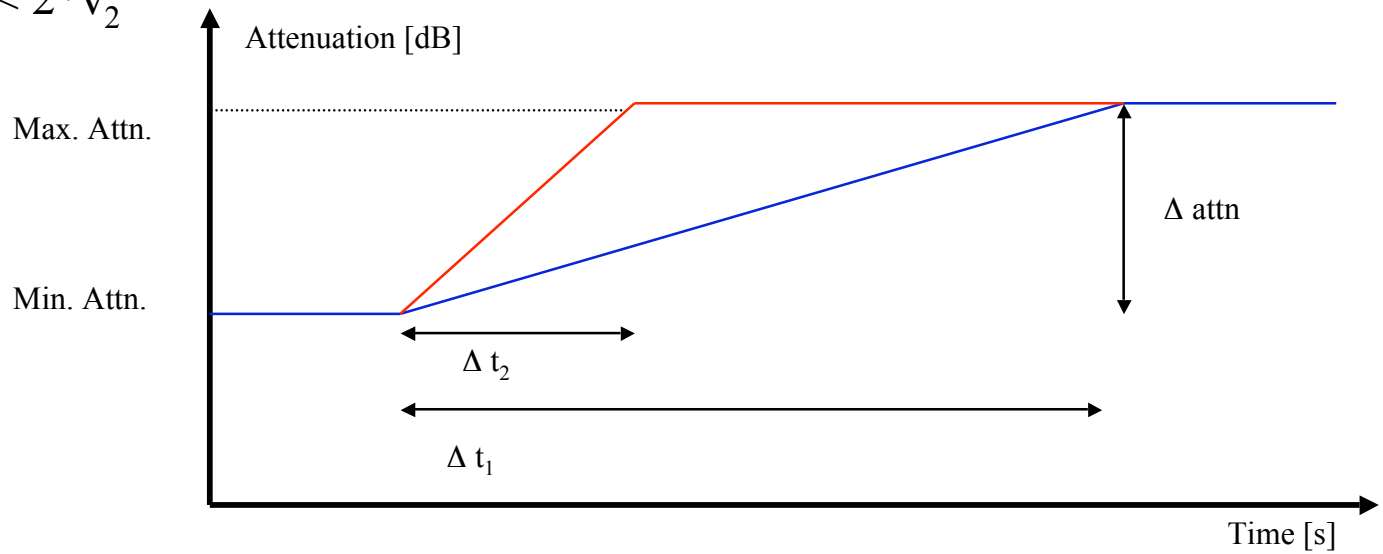
- The previous two slides were merely for illustration purposes
- The proposed draft text is a measurement methodology and does not specify any specific metric.
- The methodology shall be applied in every measurement of a metric using a conductive environment in which the experienced attenuation is changed while conducting the measurement.

Involved Test Equipment

- Does *not* claim to be a complete list of test equipment used to establish a conducted test environment
- Does *only* focus on equipment directly involved for employing variable attenuators:
  - DUT
  - Reference AP
  - Shielded enclosure
  - Variable attenuator(s)
  - Attenuator controller & “sweep function”
  - Additional (calibrated) equipment to connect the DUT and Reference AP via the variable attenuator(s), e.g.: cables, splitters, combiner, etc.
- Extend this list according to set-up appropriate to the tested metric / sub-metric.

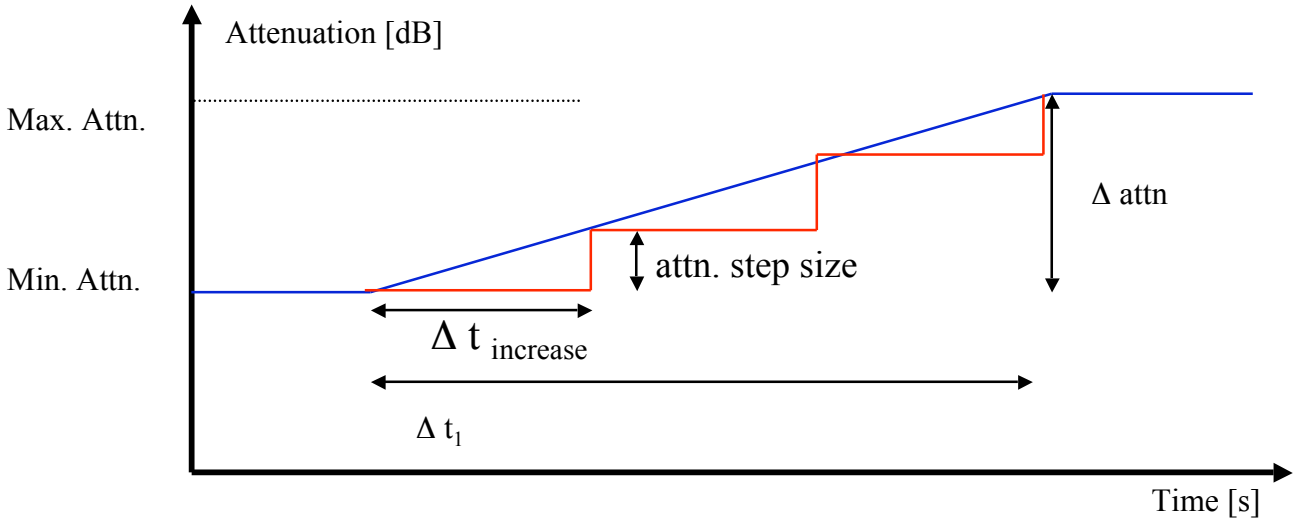
Methodology: Baseline Configuration

- **Sweep function: Linear in dB**
- **Two velocities by which to change the imposed attenuation:**
  - Sweep times: Δt_1 and Δt_1
  - Δ attn = Max.Attn. - Min.Attn
  - $v_1 = \Delta$ attn / Δt_1
  - $v_2 = \Delta$ attn / Δt_2
  - $v_1 << 2*v_2$



Methodology: Baseline Configuration (cont.)

- **Increase of imposed attenuation in discrete step sizes permissible**
  - Attenuation step size shall be constant
  - Step interval ($\Delta t_{increase}$) shall be constant
  - Keep step interval as small as possible



- **Interruption of the RF path due to the change of imposed attenuation shall be as short as possible according to used equipment.**

Methodology: Modifiers

- **Modifiers**
  - Sweep function
  - Velocity by which to change imposed attenuation
  - Change only one modifier at a time

Methodology: Special Reporting Requirements

- **Min. attenuation**
- **Max. attenuation**
- **Sweep time**
- **Sweep function**
- **Time RF path is interrupted due to change of attenuation**
- **For step-wise approximation of attenuation linear in dB:**
  - attenuation step size
  - time over which attenuation is kept constant

Conclusion

- **The speed at which the imposed attenuation is changed influences measurement results for certain metrics**

- **Presented methodology assures that**
  - reported results will be more precise and repeatable
  - allows to incorporate “mobility” issues into measurements in a reproducible manner

Discussion

Motion

- **Request the technical editor to include the draft text proposal "Methodology for Employing Variable Attenuators in a Conducted Test Environment" (doc. 05/702r2) into the 802.11.2 Draft.**

- **Proposed:**
- **Seconded:**

- **Result (for/against/abstain):**

References

[1] Range vs. Rate (doc. 04/1397r00)

[2] BSS Transition Time (doc. 04/0989r01)

[3] Velocity Effects on RSM-Based Handover Decision (doc. 05/233r03)

[4] Marc Emmelmann. "Influence of Velocity on the Handover Delay associated with a Radio-Signal-Measurement-based Handover Decision". In Proc. of IEEE Vehicular Technology Conference (VTC 2005 Fall), Dallas, TX, USA, September 2005.

[5] Performance Testing of Diversity for 802.11(doc. 05-0194r00)

[6] BSS Transition Time -- draft text proposal (doc. 05/0537r0)

[7] TGT Conductive Test Environment and Metrics, Draft Text Proposal (doc. 05/0660r0)

[8] TGT Conductive Test Environment and Metrics, Draft Presentation (doc. 05/0661r0)

[9] TGT Conductive Test Environment (doc. 05/419r1)

P802.11.2-D0.1 - Draft Recommended Practice for the Evaluation of 802.11 Wireless Performance