

Context Description: Posted Dec. 1, 2006

This draft report was prepared by NIST staff at the request of the Technical Guidelines Development Committee (TGDC) to serve as a point of discussion at the Dec. 4-5 meeting of the TGDC. Prepared in conjunction with members of a TGDC subcommittee, the report is a discussion draft and does not represent a consensus view or recommendation from either NIST or the TGDC. It reflects the conclusions of NIST research staff for purposes of discussion. The TGDC is an advisory group to the Election Assistance Commission, which produces voluntary voting system guidelines and was established by the Help America Vote Act. NIST serves as a technical advisor to the TGDC.

The NIST research and the draft report's conclusions are based on interviews and discussions with election officials, voting system vendors, computer scientists, and other experts in the field, as well as a literature search and the technical expertise of its authors. It is intended to help in developing guidelines for the next generation of electronic voting machine to ensure that these systems are as reliable, accurate, and secure as possible. Issues of certification or decertification of voting systems currently in place are outside the scope of this document and of the TGDC's deliberations.

Timing Issues for Usability

Version date: May 22, 2006

1. Introduction and Definitions

This note discusses existing and proposed VVSG requirements that relate to how long the voting equipment and voter have to wait for each other during the voting session. It does *not* cover broad performance issues for the session as a whole (e.g. average time taken to complete a ballot). The voting equipment considered herein is that with some sort of interactive interface to the voter, such as an electronic screen. Manually marked paper ballots are not covered.

There are several distinct issues to be covered. Let us start with definitions:

- **Initial response time:** the time taken from when the voter performs some detectible action (such as pressing a button) to when the equipment *begins* responding in some obvious way (such as an audible signal or any change on the screen).

- **Completed response time:** the time taken from when the voter performs some detectible action to when the equipment completes its response and settles into a stable state (e.g. finishes "painting" the screen with a new page).
 - **Timeout period:** the amount of time the equipment will wait for detectible voter activity before issuing an alert to the voter.
 - **Alert time:** the amount of time the equipment will wait for detectible voter activity after issuing an alert and then going into an inactive state requiring poll worker intervention.
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2. Response Time

The general issue of response time is: how quickly does the equipment respond to voter actions during the voting session? Obviously, quick response times positively support ease of comprehension, efficiency, and other usability factors. We will assume that only local processing is involved. Functions that may involve remote communications (such as a database lookup to verify voter registration) are not considered.

2.1 History

The draft IEEE standard specified:

5.3.6.2. The system should provide feedback to any user input or other action in less than one second.

- a. For controls that do not provide tactile feedback, there shall be instant visual (and auditory, if auditory mode is being used) feedback when a control is engaged (e.g. on "key down").
- b. If processing takes longer than one second, feedback shall indicate that the system is processing the voter's input.
- c. If the system takes more than 10 seconds to respond, it shall provide immediate feedback that the system is processing the voter's input and display an indication of the progress to completion.

VSS'02 specified:

2.4.3.3.L [The DRE shall] Provide sufficient computational performance to provide responses back to each voter entry in no more than three seconds;

3.2.6.2.1.a. [The DRE shall] Operate at a speed sufficient to respond to any operator and voter input without perceptible delay (no more than three seconds); and

VVSG'05 specified:

2.3.3.3.n. [The DRE shall] Provide sufficient computational performance to provide responses back to each voter entry in no more than three seconds.

4.1.6.2.a.i. [The DRE shall] Operate at a speed sufficient to respond to any operator and voter input without perceptible delay (no more than three seconds).

2.2 Analysis

Leaving aside the redundancy, the VVSG requirements do not distinguish between initial and completed response time, as defined above, and as recognized by the IEEE specifications. In Chapter 5 of his Usability Engineering book, and [on his website](#) Jakob Nielsen notes that:

"0.1 second is about the limit for having the user feel that the system is reacting instantaneously, meaning that no special feedback is necessary except to display the result.

1.0 second is about the limit for the user's flow of thought to stay uninterrupted, even though the user will notice the delay. Normally, no special feedback is necessary during delays of more than 0.1 but less than 1.0 second, but the user does lose the feeling of operating directly on the data."

So we know what is desirable - the remaining question seems to be what is feasible for the vendors.

RECOMMENDATION: The VVSG should adopt a requirement stating the maximum initial and completed response time to voter actions. These maxima should be no greater than 1 and 3 seconds respectively. Ideally they should be set lower, perhaps to 0.5 second and 1 second, but this should be done only after consultation with the vendor community.

3. Handling Voter Inactivity

What must the equipment do if there is a prolonged period of voter inactivity? The thrust of the requirements below is that such inactivity should be noticed, and an alert issued. Within a short period thereafter, if the voter interacts with the system, the voting session resumes normally, otherwise poll worker intervention may be required.

3.1 History

The draft IEEE standard specified:

5.3.6.3. If the system requires a voter input within a specific time period, it shall alert the voter before this time period has expired and provide a means to receive additional time.

a. The system shall allow voters a minimum of 15 seconds (preferably longer) to respond, before the end of the "time out" occurs. (Inspection)

VSS'02 specified:

2.2.7.2.g. For a system that requires a response by a voter in a specific period of time, alert the voter before this time period has expired and allow the voter additional time to indicate that more time is needed;

VVSG'05 specified:

3.1.6.c. If the voting machine requires a response by a voter within a specific period of time, it shall issue an alert at least 20 seconds before this time period has expired and provide a means by which the voter may receive additional time.

3.2 Analysis

The IEEE draft and VVSG'05 both define a minimum alert time, but no standard so far has seen fit to specify any bounds for the timeout period itself. While there is no reason to think that vendors choose unreasonable values, it would be well to make sure that the equipment does in fact issue an alert after an extended period of inactivity.

VVSG is silent on whether the timeout period or alert time can be set by officials. Therefore, systems may provide this feature, but are not required to. However, the minimum alert time still applies, whether or not it is adjustable. For instance, a system might allow officials to set the alert time to any value between 20 and 40 seconds.

Some current systems do not have the ability to time out based on voter inactivity, and VVSG'05 does not require such an ability. An open question is whether this feature is important enough that it should be required of all interactive systems.

RECOMMENDATION: The VVSG should specify lower and upper bounds for both the timeout period and alert time. For the former, the bounds should be on the order of 2 and 5 minutes (i.e. the equipment will issue a timeout alert after 2 to 5 minutes of inactivity). For the latter, the bounds should be 20 to perhaps 45 seconds (i.e. the voter has between 20 and 45 seconds to respond to the alert). The VVSG should maintain its policy of allowing, but not mandating, the ability of officials to adjust the timeout period and alert time within the required limits.