3. Broadband Performance Testing Methodology

This section describes the system architecture and network programming features of the tests, and other technical aspects of the methods employed to measure broadband performance during this study.

A. Selection of Hardware Approach

A fundamental choice when developing a solution to measure broadband performance is whether to use a hardware or software approach.

Software approaches are by far the most common and allow a very large sample to be reached relatively easily. Web-based speed tests, such as the FCC's own Consumer Broadband Test, fall into this category. These typically use Flash or Java applets, which execute within the context of the user's web browser. When initiated, these clients download content from remote web servers and measure the throughput of the transfer. Some web-based speed tests also perform upload tests, while others perform basic latency checks.

Other less common software-based approaches to performance measurement involve installing applications on the user's workstation which periodically run tests while the computer is switched on.

All software solutions implemented on a consumer's computer, smart phone, or other Internet access device suffer from the following disadvantages for the purposes of this study:

- The software may itself affect broadband performance;
- The software typically does not account for multiple machines on the same network;
- The software may be affected by the quality and build of machine;
- Potential bottlenecks (such as wireless equipment, misconfigured networks, and older computers) are generally not accounted for and result in unreliable data;
- A consumer may move the computer or laptop to a different location which can affect performance;
- The tests may only run when the computer is actually on, limiting the ability to provide a 24-hour profile;
- For manually-performed software tests, panelists may introduce a bias by when they choose to run the tests (*e.g.*, may only run when they are encountering problems with their service).

In contrast, hardware approaches involve placing a device inside the user's home that is physically connected to the consumer's Internet connection, and periodically running tests to remote targets on the Internet. These hardware devices are not reliant on the user's workstation being switched on, and so allow results to be gathered throughout the day and night. The primary disadvantages of a hardware approach are that this solution is much more expensive than a software approach and requires installation of the hardware by the consumer or a third party.

B. Design Principles and Technical Approach

For this test of broadband performance, the FCC adopted design principles that were previously developed by SamKnows in conjunction with their study of broadband performance in the U.K. The design principles comprise seventeen technical objectives:

Technical Objectives	Methodological Accommodations
1. Must not change during the monitoring period.	The Whitebox measurement process is designed to provide automatic and consistent monitoring throughout the measurement period.
2. Must be accurate and reliable.	The hardware solution provides a uniform and consistent measurement of data across a broad range of participants.
3. Must not interrupt or unduly degrade the consumer's use of the broadband connection.	The volume of data produced by tests is controlled to avoid interfering with panelists' overall broadband experience, and tests only execute when consumer is not making heavy use of the connection.
4. Must not allow collected data to be distorted by any use of the broadband connection by other applications on the host PC and other devices in the home.	The hardware solution is designed not to interfere with the host PC and is not dependent on that PC.
5. Must not rely on the knowledge, skills and participation of the consumer for its ongoing operation once installed.	The Whitebox is "plug-and-play." Instructions are graphics-based and the installation process has been substantially field tested.
6. Must not collect data that might be deemed to be personal to the consumer without consent.	The data collection process is explained in plain language and consumers are asked for their consent regarding the use of their personal data as defined by any