# WiSlow: A Performance Troubleshooting Tool for Wi-Fi Networks

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## 1 Motivation

Today, it is common for a household to install a wireless Access Point (AP) for its home network. However, the increasing number of APs and wireless devices inevitably results in more contention and interference, which causes unsatisfactory Wi-Fi network performance. Furthermore, isolating the root causes of poor performance is nontrivial because the problem may be caused by collision with packets from other Wi-Fi devices using the same channel, i.e., channel contention or interference from non-Wi-Fi devices such as microwave ovens, cordless phones, and baby monitors. Since these devices and 802.11b/g operate on the same 2.4-GHz spectrum, they generate severe interference when they operate together [3]. Although these sources of problems can be easily removed in many cases (e.g., by relocating the baby monitor), it is difficult for technically non-savvy users to even notice the existence of channel contention or non-Wi-Fi interference. Instead, properly working routers or service providers are frequently misidentified as the culprit.

## 2 WiSlow Overview

We introduce WiSlow ("Why is my Wi-Fi slow?"), a tool that uses packet monitoring and peer collaboration to diagnoses the root causes of poor Wi-Fi performance. In contrast to another approach [2], we focus on identifying the causes without any additional hardware (e.g., spectrum analyzer [1]). Instead, we monitor the behavior of 802.11 packets such as packet loss, retries, bit rate, signal strength, and signal-to-noise ratio (SNR), which can be observed on ordinary operating systems. Our experimental results show that the statistical patterns of the above variables vary depending on the source of the problems. For example, in a case of channel contention, the number of packets lost was less and bit rate fluctuated more quickly compared to a case of non-Wi-Fi interference. In addition, baby monitors induced more SNR degradation than microwave ovens. To improve the accuracy of the algorithm, WiSlow also uses a heuristic method that considers the history of the interference period and matches it to common use-cases of the devices (e.g., microwave ovens are often used occasionally only for 5 - 30 min, whereas baby monitors are used continuously) to ascertain the source of the problem. Based on these experimental results and the heuristic method, we develop an algorithm that successfully distinguishes channel contention from non-Wi-Fi interference and partially infers the product type of the offending device. We believe that this technology will be useful to end users since it can inform them of what needs to be done in order to improve the performance of their networks - whether to increase Internet bandwidth or remove a device that is causing interference.

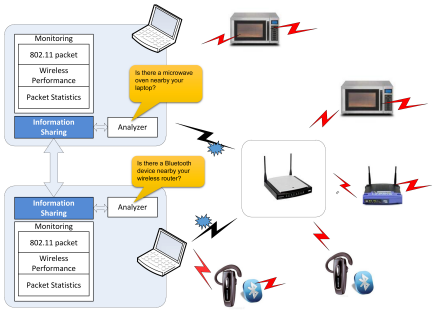

Figure 1: WiSlow

In non-Wi-Fi interference scenarios, another goal is to identify the location of the source of interference. Although it is difficult to pinpoint the exact physical location of the source, we can infer the relative location of the problem source by collaborating with other computers using the same wireless network. WiSlow collects the patterns of variables from peers and determines whether the interference is observed by others at the same time. If it is observed by all the machines, it is highly likely that the problematic source is close to the wireless AP. However, if only one of the peers observes the interference, the source is likely to be located close to that peer. Our experimental results clearly show that this approach is feasible.

In summary, WiSlow uses information obtained from packet capturing and other users to (i) distinguish channel contention from non-Wi-Fi interference, (ii) partially infer interference sources, and (iii) point the approximate location of the sources of interference.

The poster will discuss details of our experimental results and diagnosis algorithm. Our demonstration will present an actual running application that diagnoses the cause of Wi-Fi performance degradation and returns reports such as "*It appears that a baby monitor, which is located close to your router, is interfering with your Wi-Fi network*" to users.

[1] Wi-Spy. `http://www.metageek.net/`. [Online; accessed Feb 2013].

[2] A. Baid, S. Mathur, I. Seskar, S. Paul, A. Das, and D. Raychaudhuri. Spectrum mri: Towards diagnosis of multi-radio interference in the unlicensed band. In *Proceedings of IEEE WCNC*, Mar. 2011.

[3] S. Gollakota, F. Adib, D. Katabi, and S. Seshan. Clearing the rf smog: making 802.11n robust to cross-technology interference. In *Proceedings of ACM SIGCOMM '11*.