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A Characterization of Wireless Network Interface Card Active Scanning Algorithms

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A CHARACTERIZATION OF WIRELESS NETWORK INTERFACE CARD ACTIVE SCANNING ALGORITHMS

by

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Under the Direction of Raheem A. Beyah

ABSTRACT

In this thesis, we characterize the proprietary active scanning algorithm of several wireless network interface cards. Our experiments are the first of its kind to observe the complete scanning process as the wireless network interface cards probe all the channels in the 2.4GHz spectrum. We discuss the: 1) correlation of channel popularity during active scanning and access point channel deployment popularity; 2) number of probe request frames statistics on each channel; 3) channel probe order; and 4) dwell time.

The knowledge gained from characterizing wireless network interface cards is important for the following reasons: 1) it helps one understand how active scanning is implemented in different hardware and software; 2) it can be useful in identifying a wireless rogue host; 3) it can help implement Active Scanning in network simulators; and 4) it can radically influence research in the familiar fields like link-layer handovers and effective deployment of access points.

INDEX WORDS: IEEE 802.11 Active Scanning, Probe Request Frame, Wireless Network Interface Card, Host Association

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SCANNING ALGORITHMS

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DEDICATION

To all the nameless inventors and researchers,

who ameliorate our lives but never get acknowledged.

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LIST OF ABBREVIATIONS

AP	Access Point
CDF	Cumulative Distribution Function
IEEE	Institute of Electrical and Electronics Engineer
IDS	Intrusion Detection System
IV	Initialization Vector
LAN	Local Area Network
MAC	Media Access Control
OS	Operating System
PRF	Probe Request Frame
QoS	Quality of Service
TCP/ IP	Transmission Control Protocol/ Internet Protocol
WEP	Wired Equivalent Privacy
WNIC	Wireless Network Interface Card

CHAPTER 1 - INTRODUCTION

With the advent of IEEE 802.11 wireless standards [1], it has become easier to connect to other networking devices. These IEEE 802.11 standards have become popular due to ease in the deployment of LANs, without requiring wired Ethernet as the connecting medium. The cheap cost of the equipment required to create wireless LANs, its ability to support high data rates and the dynamic expansion this network architecture supports, is among the few reasons for its widespread popularity. Supporting its omnipresence, more than 70 million 802.11 enabled devices were sold worldwide in the second quarter of 2006 [2].

The rise of new networking standards like IEEE 802.16 (WiMax) and IEEE 802.16e (Mobile-WiMax) [3] has ensured that not only is wireless networking here to stay, but will become more adaptable and widespread, ensuring better QoS and higher data rates.

Drawing comparisons with the wired Ethernet, wireless networks also suffer from all the security problems that plague the wired networks. Much is due to the fact that the wireless networks are more of an extension of the wired Ethernet standards. These standards are relatively new and are not thoroughly designed to meet the current QoS needs. Wireless networks also suffer from certain security problems, which are pertinent to only this kind of network architecture.

This chapter introduces the problems dealing with rogue host identification, efficacy of access point deployment and efficient Media Access Layer Handovers.

The 802.11 wireless networks suffer from some peculiar problems unlike the wired networks. As the hosts are not physically connected to the access point and share the unlicensed Industrial Scientific and Medical 2.4GHz spectrum, it is easier for a rogue host to access this network. The three fundamentals required at the MAC layer for securing the network communications are confidentiality, integrity and access control. Confidentiality certifies that the data being sent can only be interpreted by the intended receiver. Integrity ensures that this data is not manipulated. And access control ensures that only legitimate users have access to the wireless network.

The WEP is the most common method used to secure an IEEE 802.11 wireless network, servicing the above security needs. WEP in the original IEEE 802.11 standard has the following cryptographic weaknesses [4]:

1) The IV is too small:

WEP uses the IV along with the WEP encryption key as the input to the RC4 pseudo-random number generator, which produces a key stream that is used to encrypt the 802.11 frame payload. With a 24-bit WEP IV, it is easy to capture multiple WEP frames with the same IV value, making real-time decryption easier.

2) Weak data integrity:

WEP data integrity consists of performing the Cyclic Redundancy Check-32 checksum calculation on the bytes in the unencrypted 802.11 payload and then encrypting its value with WEP. Even encrypted, it is relatively easy to change bits in the encrypted payload and then properly update the encrypted CRC-32 result, preventing the receiving node from detecting that the frame contents have changed.

3) Uses the master key rather than a derived key:

The WEP encryption key, either manually configured or determined through 802.1X authentication, is the only available keying material. Therefore, the WEP encryption key is the master key. Using the master key to encrypt data is less secure than using a key derived from the master key.

4) No re-keying:

WEP does not provide for a method to refresh the encryption keys.

5) No replay protection:

WEP does not provide any protection against replay attacks, in which an attacker sends a series of previously captured frames in an attempt to gain access or modify data.

To exploit these weaknesses of the WEP, a large number of tools can be freely downloaded from the Internet. Thus, it is has become easier to eavesdrop on a particular wireless communication, compromise the login credentials of a legitimate user, and then access the secure network. To overcome such a security flaw, many methods have been proposed and some among them are being utilized. Profiling a host machine and then using the profiled knowledge to provide access to the network is a common approach. This profiling can use one or more combinations of the following methods: MAC address, OS fingerprinting using TCP/IP stack, pre-installed software for authentication on the host machine.

Profiling/ characterizing known security attacks, hardware and software which can be used for such attacks, is a known method for fingerprinting and creating signatures and can be used in a real attack scenario. A good example for this would be the previous successful profiling in the field of denial of service attacks [5], Bluetooth devices [6], network worms [7], etc.

Software tools like Nmap [8], P0f [9], etc. can be freely downloaded from the Internet to fingerprint an OS.

Using the same approach of fingerprinting hardware and software remotely, our characterization attempt is the first of its kind in the research community to passively listen on all the channels of the IEEE 802.11 2.4 GHz spectrum. The benefits of this approach and the choice of profiling which we undertake has innumerous and unparallel advantages which are discussed in the following sections. Such an approach when employed remains effective even when an attacker attempts to manipulate the hardware/software configurations of his own machine.

A key reason for choosing this kind of profiling is to attempt to understand the active scanning algorithm which is a part of IEEE 802.11 MAC layer functions. The information gathered from profiling these WNICs can be used to effectively deploy APs. It is a common approach to deploy APs on channels 1, 6 and 11. Previous researches have shown that the time a WNIC spends scanning for APs is the highest among all the activities during the association phase [10]. However, no effort has been made by the research community to understand the reasons behind it. We experimentally find the reasons behind this occurrence and show how the current AP deployment schemes and the active scanning algorithms used by the WNICs can be held responsible for such large scanning overheads which directly affect the QoS standards. Reducing these active scanning overheads can drastically reduce the AP handover delays. An AP handover delay can be described as the time it takes for a host machine to scan and associate with another AP and dissociating with the previously associated AP. These scanning delays if removed can help provide better QoS, namely for seamless audio and video connectivity.

Another key application of our work is in the field of wireless network simulations. As we discuss in chapter 3, we noticed that all network simulators ignore using active scanning parameters and its values while creating a simulation. Our profiled data can be of great importance, which helps characterizing different WNIC hardware and software's. Such information can be directly used in network simulators, improving the accuracy of simulations. Without such knowledge in the simulating environment, the results of any wireless experiments can be challenged for its accuracy.

CHAPTER 2 – OVERVIEW OF WIRELESS NETWORK INTERFACE CARD

The essential hardware to communicate on a wireless channel is a WNIC. A WNIC is responsible for handling the management and the data level communication with another host or an AP. To do so, the IEEE 802.11 standard specifies two layers:

a) The Physical Layer (PHY Layer)

b) The Medium Access Control Layer (MAC Layer)

The PHY layer is embedded in the hardware of the WNIC. It is responsible for encoding and transmission of data over various network communication media. Our work focuses on the MAC layer functions. The MAC Layer is responsible for managing and maintaining communication between various networking devices. It coordinates access to a shared radio channel and utilizes standardized protocols to facilitate communication between these devices. We profile the active scanning algorithm, which is an integral function of the MAC Layer.

2.1 - Active Scanning

The IEEE 802.11 standard specifies the essentials of all the services a WNIC should implement. However, some of the features have been left vaguely specified for a WNIC manufacturer to implement. It is the set of these features that we use to profile a WNIC.

Scanning for wireless networks is an important function of the IEEE 802.11 MAC protocol. The wireless node attempts to search for active wireless networks and then attempts to associate with them. The IEEE 802.11 standard defines both types of scanning techniques; active scanning and passive scanning. In passive scanning mode, the WNIC listens on one channel at a time for Beacon Frames from APs [11]. It records the corresponding signal strength and other relevant information about the AP. Using this information, the WNIC then chooses which AP to associate with. In the case of active scanning, PRFs are transmitted on all the channels. The responses received from APs in the form of Probe Response Frames are then subsequently processed by the WNIC [11]. Active scanning is the default scanning technique for a WNIC, which enables it to implore an immediate response from an AP, without waiting for the beacon frames to be sent by it.

Following are the guidelines described in the IEEE 802.11 MAC Layer standard for active scanning [1]. For each channel to be scanned:

a) Wait until the ProbeDelay time has expired or a PHYRxStart.indication has been received.
b) Perform the Basic Access procedure to determine it may transmit.
c) Send a probe (PRF) with the broadcast destination, SSID and broadcast BSSID.
d) Clear and start a ProbeTimer.
e) If PHYCCA.indication (busy) has not been detected before the ProbeTimer reaches MinChannelTime, then clear Network Allocation Vector and scan the next channel, else when ProbeTimer reaches MaxChannelTime, process all received probe responses;
f) Clear Network Allocation Vector and scan the next channel.

ProbeDelay is the delay to be used prior to transmitting a PRF on a new channel. MinChannelTime is the minimum amount of time to be spent on each channel. MaxChannelTime is the maximum amount of time to be spent on each channel.

2.2 – Parameters for Distinction

As mentioned in Chapter 2.1, the active scanning procedure is not thoroughly defined in the IEEE 802.11 standards, resulting in WNIC manufacturers to implement their proprietary active scanning algorithms.

The parameters that can vary depending on the WNIC include:

a) Channel on which the 1^{st} PRF is sent

b) Number of PRFs sent

c) Burstiness of PRFs

d) Probe delays between PRFs (dwell time)

e) Order of channels probed

These parameters govern the performance of any active scanning algorithm.

CHAPTER 3 - RELATED WORK

In this chapter, we briefly highlight the previous attempts to characterize the active scanning algorithm. We list the limitations of some of the previous work done in this field and empirically provide our analysis.

It has been shown on previous occasions that active scanning algorithm is an important parameter which can help profile different WNICs [12, 13]. Previous attempts in the research community to profile the active scanning algorithm have remained inclined to sniffing on selective channels. These selective channels are either randomly chosen or have been based on limited study [12, 13]. However, the focus has mainly resided on passively listening on selective channels, trying to distinguish one WNIC from another. Our work takes a more expansive approach by listening on all the channels of the IEEE 802.11 2.4GHz spectrum. Such an approach is not biased to gather information on only few channels and rather gathers information on all the 11 channels (2.4GHz spectrum for USA) of the wireless spectrum. This approach allows us to not only distinguish WNICs more precisely, but to fundamentally characterize the proprietary active scanning algorithm for each WNIC chipset.

Also, there have been many successful attempts to create more efficient active scanning algorithms [14, 15, 16]. Different techniques like selective active channel scanning, network neighborhood graphs, fast active scanning, etc. have been proposed to cut down the AP handover latency. The focus of these algorithms has solely resided in providing a faster active scanning algorithm without understanding the previous existing active scanning algorithms and their needs. It is imperative to thoroughly understand the existing active scanning algorithm before trying to write newer algorithms. The reason why we lay emphasis on this is due to the fact that several researches have made assumptions that were found to not hold as per our experiments [15, 17, 18]. Most of the new active scanning algorithms have been proposed after being simulated or tested in controlled environments only. Such kind of a controlled environment is very sensitive to parameters which help simulate the environment. Any inaccurate or wrong parameter and its value can lead to an environment which is biased. Not knowing the parameters that can influence the performance of the active scanning algorithm and the values of these parameters, defeats the effectiveness of the new active scanning algorithm applied in the real world scenario. We describe this problem in more details in chapter 4.

CHAPTER 4 - MOTIVATION

Simulation tools like OPNET [19], NS-2 [20], GTNeTs [21], etc. do not take active scanning into consideration. The only simulation tool we noticed that takes active scanning into consideration is QualNet [22]. However, we did not find parameters which were WNIC specific that could be introduced into any simulated environment. This approach does not distinguish the active scanning algorithm of one WNIC from another, which neglects the dynamic behavior of active scanning that change with each implementation. Our work helps by laying guidelines to the parameters and their values which should be added to every wireless research and simulation.

Also lately, a lot of effort by the research community has been focused on reducing the link-layer handover delays of hosts between APs, which typically ranges from 300-550ms [10]. Without a thorough understanding of how a WNIC behaves while scanning for APs, it is difficult to introduce an effective scheme which can reduce these handover delays. Almost 90% of the time in a handover process is spent scanning for wireless networks [10, 16]. Reducing these active scanning delays is necessary for improving the quality of service, namely for seamless audio and video connectivity.

The same knowledge can be applied for efficient deployment of APs in a wireless network. With the knowledge of how different active scanning algorithms work, APs can be deployed on the channels from which the WNICs start scanning, thereby reducing the initial association time.

Another important encouraging factor is the promising use of our work in wireless network security. Such a detailed profiling of WNICs can be useful for network administrators for detecting unauthorized WNICs types. Techniques like MAC address spoofing and password phishing are known to easily circumvent security policies. But it is difficult to change the signature of a WNIC. Such profiling of wireless hardware has applications in both military and civilian use.

CHAPTER 5 - EXPERIMENTAL SETUP

This chapter describes the experimental setup of the host using different WNICs and the sniffers employed to passively listen on all the 11 channels. The test-bed was verified to be free from any interference from other wireless devices operating on the same 2.4 GHz spectrum.

5.1 - Hardware Setup

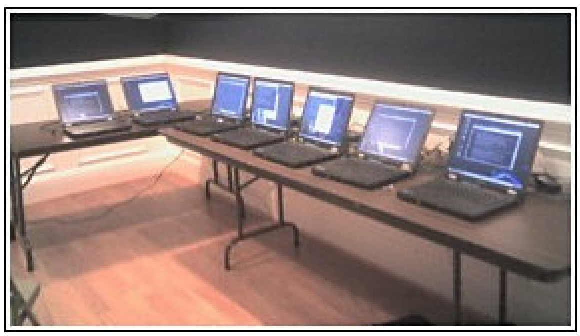

Figure 1. Test-bed

For passively listening on all the channels, a total of 6 Lenovo 3000 C100 laptops running Fedora Core 4, kernel ver. 2.6.11-1.1369 with 512 MB RAM were used. The sniffer used the internal Intel PRO/Wireless 2915ABG WNIC.

5.2 - Software Setup

To listen/ sniff the frames on the wireless network, the Intel PRO/Wireless 2915ABG WNIC was used with the driver ipw2200 ver. 1.1.2 and firmware ver 3.0 [23]. The ipw2200 driver allows the WNIC to be put on the monitor mode. Monitor mode (RFMON mode) allows a WNIC to sniff all the wireless traffic on a particular channel to which the WNIC is tuned. Monitor mode is similar to the promiscuous mode used for packet sniffing in wired networks. To obtain the channel number for each frame, radiotap header [23] was enabled. The radiotap header was originally designed for Berkley Software Distribution. The radiotap header format provides additional information about frames, from the driver to user-space applications such as *libpcap* [24], and from a user-space application to the driver for transmission. To synchronize the captures on all the 6 laptops, Network Time Protocol [25] via the Linux utility *crontab* was used. The captures were made using the tool *tcpdump* [26] and each trial span for four minutes. These captures were synchronized and automated via the *crontab*.

To parse the capture traces and selectively pick the desired information from these traces, a *C* language based parser was written. The files generated from this parser were used to create MATLAB [27] structures. We wrote several MATLAB programs which used these MATLAB structures and provided us a wealth of statistical information necessary for concluding our experiments.

5.3 - Experimental Problems

Our initial attempt was to use an external WNIC along with the internal WNIC. The goal was to capture traffic on the entire spectrum of 11 channels using the 6 laptops. We were able to use Airlink AWLC4030 and the D-Link DWL-650 WNICs using the Madwifi ver. 0.9.2 driver [28] for this purpose. But we observed that these two WNICs using the Madwifi driver captured one-third or even fewer frames compared to the internal Intel 2915 WNIC. One theory for this could be that the Hardware Abstraction Layer [28], which is part of the Madwifi driver, down samples the number of PRFs. As a result of the poor performance of the WNIC and driver combination, we decided to only use the internal Intel 2915 WNIC. Thus, our experiments were broken down into two sets of channels.

We first conducted 100 trials for channels 1-6 and then another 100 trials for channels 7-11 for each of the WNIC. We then merged these files successively, removing the difference in the timestamps from when these two sets of experiments were started. Thus, we were able to examine the activity on all 11 channels for each WNIC for a given period. The wealth of information resulting from examining the entire 2.4GHz spectrum is far more accurate than examining selective channels at a time.

5.4 - Integrity of the Results

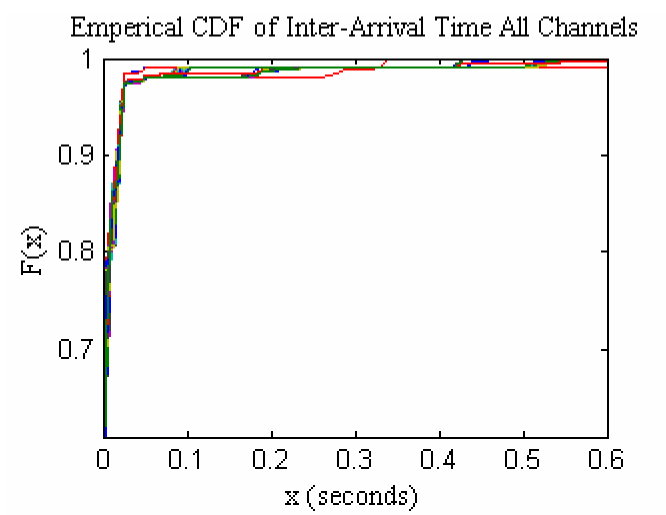

Figure 2(a). CDF of Inter-Arrival Time for Intel (All channels, 100 trials, interval 10^{-3} seconds)

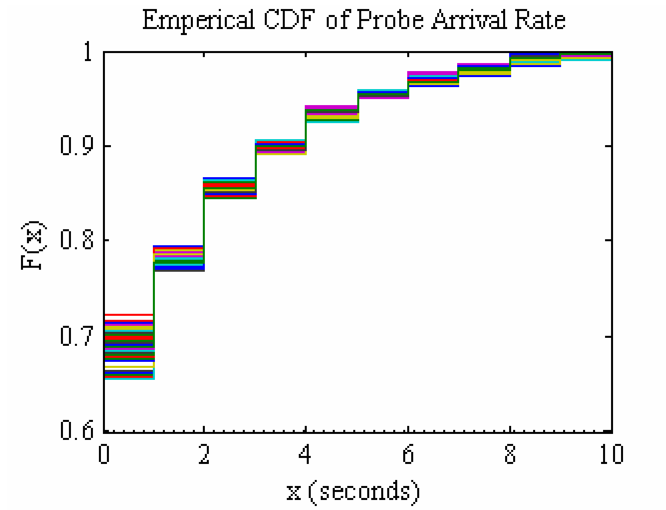

Figure 2(b). CDF of Probe-Arrival Rate for Intel (All channels, 100 trials, interval 10^{-3} seconds)

To ensure that the capture files were merged properly, we plotted the CDF, Fig. 2(a), showing the Inter-Packet Arrival Time and Fig. 2(b), showing the Probe Arrival Rate for Intel PRO/Wireless 2915ABG WNIC for each trial. We notice that there is a significant overlap between trials in the CDF plot. This asserts that each trial followed a similar pattern and our approach of merging the files preserved the integrity of the experimental data. We did the above two CDF plots for all the WNICs we profiled. The integrity of the experiments was found to be consistent for all the WNICs.

5.5 – Wireless Network Interface Cards Profiled

The WNICs profiled and the drivers used by them are mentioned in Table -1. For ease of discussion, throughout this report we will address these WNICs as Airlink, D-Link, Intel, Link-P, Link-H, Cisco and Lucent respectively. All the WNICs were external (PCMCIA based) except the Intel, which was an internal WNIC.

Table 1. WNICs profiled and the drivers used

WNIC	Driver
Airlink AWLC4030	Madwifi ver. 0.9.2.
D-Link Air DWL-650	Madwifi ver. 0.9.2.
Intel PRO/Wireless 2915ABG	IPW2200 ver. 1.1.2.
Linksys WPC11	Prism2_cs
Linksys WPC11	Host AP ver. 0.4.9
Cisco Aironet 350	Airo_cs
Lucent Orinoco Gold PC24E-H-FC	Orinoco_cs

As noticed in Table - 1, we performed two sets of profiling for Linksys WPC11 using two different drivers. Also, Airlink and D-Link were profiled using the same Madwifi driver. Both of these WNICs use different chipsets (supports 802.11b/g/SuperG and 802.11b respectively) made by the same manufacturer, Atheros. Our goal was to examine two scenarios: 1) the effect of change in drivers on the same hardware; and 2) the effect of change in hardware (even when having a common manufacturer but different chipsets), keeping the same driver. The goal was to understand how different permutations of hardware and software configurations affect the behavior of the active scanning process.

CHAPTER 6 – EXPERIMENTAL RESULTS

In this chapter, we examine the data generated from our experiments. This data was statistically analyzed using the MATLAB, mainly focusing on the following: 1) channels receiving the first probe request frame; 2) the number of PRFs; 3) burstiness of PRFs; 4) sequence/order of PRFs; and 5) dwell time with respect to the channel number. As a part of this chapter, we include the inferences from the experiments which meet the motivation and objective for this thesis research work.

6.1 - Channels Receiving the 1st Probe Request Frame

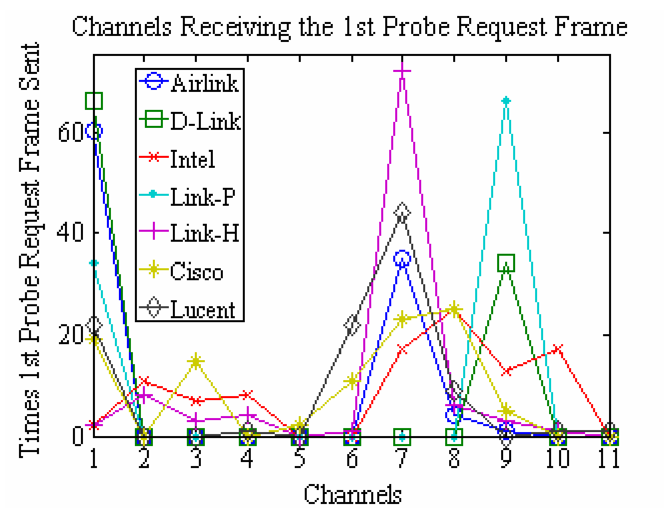

Figure 3. Channels receiving the 1st PRF (All channels - 100 trials)

A widely held belief is that active scanning starts from channel 1 [15, 17, 18]. We found no experimental proof to validate this assumption. However, it was observed during all the 100 trials for all the WNICs profiled that there is no specific channel for any WNIC from which the scanning starts. Figure 3 shows the number of times the 1st PRF was sent on any of the 11 channels for all the 100 trials for each WNIC profiled.

Summarizing the 100 trials for channel 1, Airlink in 60 trials sent the 1st PRF on channel 1, D-Link in 66 trials, Link-P, Cisco and Lucent sent in 19-34 trials and Intel and Link-H sent in 2 trials only. The channel 6 only received 1st PRF from Link-H, Cisco and Lucent WNICs. The least favored channel for the 1st PRF was channel 11 where none of the WNICs except Lucent (except for one trial) sent the 1st PRF. For channel 5 only the Cisco WNIC sent the 1st PRF in 2 trials. No other WNIC in any of the 100 trials sent the 1st PRF on this channel. Similar state was for channel 2, 3, 4, and 10. Clearly there was no single channel that received the majority of 1st PRF from all the WNICs. However, the combination of channels 1, 7 and 9 received nearly 75 percent of the 1st PRFs. If an AP is set to one of these channels, it will reduce the scanning delays during the initial connection.

Also, we found no evidence that scanning is sequential in nature. That is, it does not probe the channels in an increasing order number.

These findings could be very important when APs are being setup. In a wireless network, APs are normally setup on channels 1, 6 and 11, often called the three non overlapping channels because they theoretically have minimum interference with each other. Our analysis illustrates that configuring APs to operate on these channels will increase the time required for scanning and associating with an AP. Channel 6 received very few 1st PRFs and channel 11 received only a single 1st PRF from Lucent, among all the WNICs we profiled during the 100 trials. Thus, to decrease the active scanning delays and the network traffic due to these management frames, the active scanning algorithm should start probing on the channels where APs are most likely to be deployed. Selective active scanning can be a method to achieve this [15, 29, 30].

6.2 - Number of Probe Request Frames

Table 2. Number of PRFs and their confidence percentage (All WNICs - 100 trials)

WNIC	1		2		3		4		5		6		7		8		9		10		11	
	~n	%	~n	%	~n	%	~n	%	~n	%	~n	%	~n	%	~n	%	~n	%	~n	%	~n	%
Airlink	591	94	641	64	641	71	739	96	739	91	986	73	838	83	739	85	591	96	443	88	345	80
	542	3	591	35	690	28	789	2	690	8	937	27	789	17	740	15	642	4	493	12	394	20
Dlink	168	84	168	86	168	86	168	85	168	87	168	85	168	97	168	100	168	100	168	100	168	100
	111	14	111	13	111	13	111	13	111	13	111	15	169	3								
Intel	1844	63	2233	72	2816	80	2963	62	2720	62	3350	64	3156	46	2817	55	2622	42	2329	53	1554	52
	1796	34	2282	19	2767	13	2914	24	2769	21	3302	32	3205	33	2865	30	2671	42	2282	19	1505	47
Link-P	168	99	168	99	168	99	168	99	168	99	168	99	168	100	168	100	168	100	168	100	168	100
	191	1	189	1	189	1	183	1	169	1	111	1										
Link-H	1223	88	1116	79	957	53	1063	95	1063	67	1276	95	1435	77	1329	71	1010	89	744	70	584	74
	1276	9	1063	16	904	47	1010	4	1010	32	1223	4	1382	22	1276	28	957	5	691	29	638	25
Cisco	548	80	822	74	766	51	876	84	876	62	1041	82	932	76	1041	71	766	99	657	94	548	52
	492	19	766	26	825	49	821	14	932	37	986	14	876	23	986	28	658	1	712	4	493	48
Lucent	111	99	111	71	111	100	111	99	111	99	168	41	168	100	111	99	111	100	55	67	55	100
	149	1	55	28			145	1	169	1	111	59			168	1			112	33		

The number of PRFs sent on each channel is another parameter which can help profile the scanning behavior of WNICs. Table - 2 shows the number of PRFs and their confidence percentage when put through 100 trials. Each PRF (~n) may include a range of ±2 PRFs. To further explain the table, if we examine the channel 1 for Airlink WNIC, we can deduce that 591 ±2 PRFs were sent in 94 trials. And another 542 ±2 PRFs were sent in 3 trials on this channel.

The table highlights the accuracy of results using the number of PRFs as a parameter for profiling the active scanning algorithm.

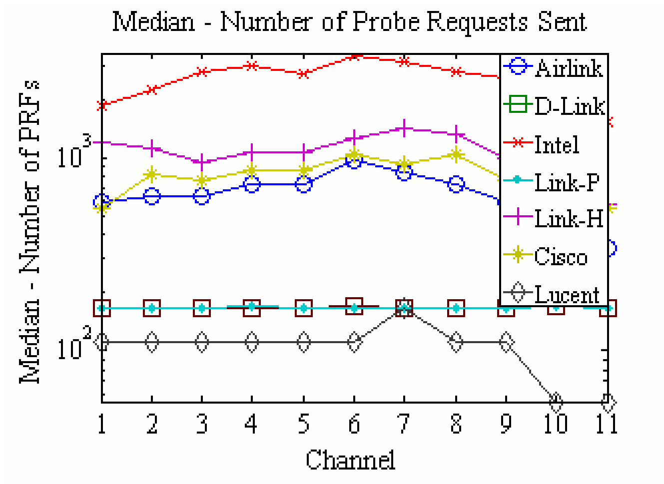

Figure 4(a). Median - Number of PRFs (All channels - 100 trials - log scale)

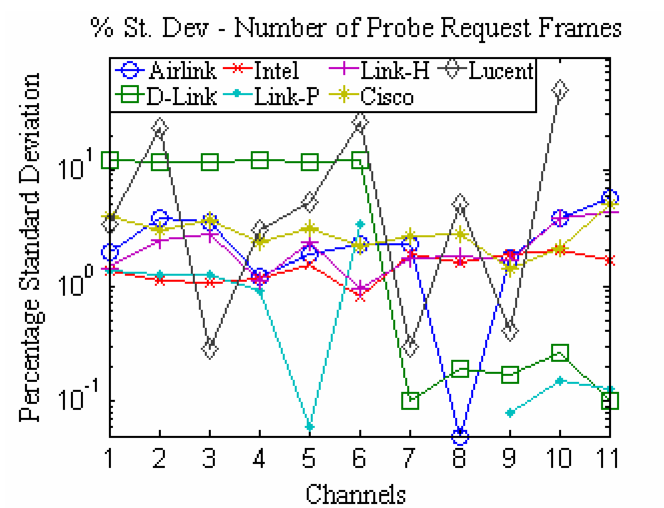

Figure 4(b). Percentage Standard Deviation of number of PRFs (log scale)

Figure 4(a) displays the median number of PRFs on each channel. Figure 4(b) plots the percentage of standard deviation in the number of PRFs for all trials. The standard deviation plot reveals that the number of PRFs sent across different trials is stable. All WNICs (except Lucent and D-Link) had less than 3% standard deviation across all trials for all channels. For channels where D-Link and Lucent exceeded 3% standard deviation, the number of PRFs fluctuated between two distinct values. For example, on channels 1 through 6, D-Link fluctuated between 111 or 168 PRFs per trial, yet 75-84% of the trials sent 168 PRFs on these channels.

For all the WNICs profiled, we observed that channel 6 received the maximum or close to the maximum number of PRFs, asserting the inclination of finding an AP on channel 6, though it received very less number of 1st PRFs.

While most of the WNICs sent a different number of probes per channel, 2 WNICs probed all channels equally (D-Link and Link-P). Lucent probed channels 1-6, 8 and 9 equally, sending 111 PRFs. Channel 7 received 168 frames and channels 10 and 11 each received 55 PRFs. The scanning algorithm of the Intel WNIC was much more aggressive than the other WNICs, sending 2.5 times more PRFs than the next highest WNIC, Link-P. Compared to the WNIC sending the least number of PRFs (Lucent) on channel 6, Intel sent nearly 25 times more PRFs. When the Linksys WNIC is used with the Host AP driver (Link-H), the WNIC behaves more aggressively sending 2 to 6 times more PRFs per channel. When the Linksys WNIC is used with the Prism driver (Link-P), the WNIC sends an equal number of PRFs across all channels. From this scenario we can infer that the scanning algorithm is highly influenced by the driver software. The reason for this assumption is that the Host AP driver can be configured to make the WNIC behave as an AP. It provides configuration to make it behave in managed (host mode) as well as master mode (AP mode). Such configuration may directly result in tweaking the active scanning behavior, as previously observed.

When comparing Airlink and D-Link, which are two WNICs with chipsets from the same manufacturer (Atheros) that used the same driver (MadWifi), we also noted distinctive behavior. The Airlink WNIC sent 4 to 8 times more PRFs per channel, while the D-Link WNIC sent a constant number of PRFs across all channels. The differences could be attributed to the fact that the chipset of each WNIC are different versions or the WNIC vendor imposed there own limitations on the scanning process.

We also noticed an unexpected observation between two WNICs. The D-Link and Link-P WNICs behave almost identically sending a constant number of PRFs across all channels, despite the fact that the WNICs are based on two different chipsets and used different drivers. This unique observation warrants further investigation as part of our future work to explain this behavior.

The statistics regarding the number of PRFs varied greatly across the set of WNICs we analyzed. Some WNICs were more aggressive in the number of PRFs sent. Some WNICs exhibited a steady scanning algorithm probing different channels equally, while other scanning algorithms favored certain channels. The analysis also illustrates the impact that the hardware and driver software combination has on the number of PRFs.

6.3 - Burstiness of Probe Request Frames

Burstiness can be defined as a peculiar nature of the active scanning algorithm, when it probes the channel more than once, without probing any other channel in between.

Burstiness can be subcategorized as follows:

1) Burstiness when scanning starts, which is, if more than one PRF is sent on the first channel it dwells on, without probing any other channel in between.

2) Burstiness after scanning starts, sending more than one PRF on a given channel, during the complete trial.

It was interesting to observe that the Intel WNIC behaved very distinctly from the other WNICs. All the other WNICs exhibited no burstiness (sent one PRF on a channel) or at times sent two or more PRFs on a particular channel. Whereas, the Intel WNIC displayed a higher degree of burstiness for the above two sub categories. Intel was the only WNIC which in 70% of the trials sent burst of PRFs ranging from 2 -19 when it sent the 1^{st} PRF. Unlike the other WNIC it continued sending more than one PRF when dwelling on any channel, which was quite commonly observed for this WNIC.

6.4 - Sequence/ Order of Probe Request Frames0

The order of the channels probed is unique to every active scanning algorithm. Among all the WNICs profiled, 2 WNICs showed a non random order of probing the channels. The first WNIC was the D-Link, which always cyclically probed the channels in the following sequence of channel numbers: 1,5,2,6,3,4,9,10,11,8.

The second WNIC which demonstrated a static sequence of probing the channels was Link-P. The WNIC always probed in the following sequence or in a sequence quite similar to: 1,5,2,6,3,4,9,10,7,11,8. The rest of the WNICs followed a pseudo random probing sequence which needs our further investigation. Undoubtedly, the order of probing for each WNIC is unique, which can act as a very useful parameter for distinction of various WNICs.

6.5 - Dwell time with respect to Channel Number

The dwell time is defined as the amount of time spent by a WNIC on a channel. Dwell time between two probes is calculated by subtracting the arrival timestamp of the former PRF from the later PRF. By taking the channel number of the PRF into account, the dwell time on each channel can be calculated. Figure 4(c) shows the median dwell time for all the WNICs on each of the channel.

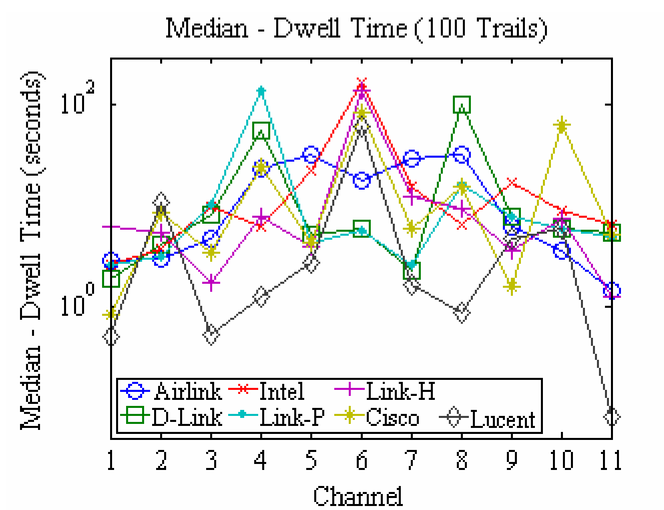

Figure 4(c). Median Dwell Time for PRFs (log scale)

An interesting observation was that the dwell time varied for each channel and each WNIC, i.e. the MinChannelTime was found to be channel specific. Another observation was that almost all the WNICs dwelled a substantial amount of time scanning on channel 6, reflected as the peaks on channel 6 in Figure 4(c). We found it to be due to either of two reasons: 1) there were a larger number of PRFs on a particular channel, thereby increasing the dwell time; or 2) the WNIC actually dwelled longer on a particular channel before scanning the next channel. One hypothesis is that the active scanning algorithm keeps cycling back to a particular channel(s), expecting some AP activity on it. For example, Intel had a high dwell time on channel 6, even though it sent almost the same number of PRFs as on channel 7. The dwell time on channel 6 was close to 11 times more than that on channel 7.

CHAPTER 7 – DISTINGUISHING WNICS USING PRF STATISTICS

Table 3. Various statistical characteristics of Intel, Link-P and Lucent WNICs

Channel	1	2	3	4	5	6	7	8	9	10	11
1st PRF Sent											
Intel	2	11	7	8	0	0	17	25	13	17	0
Link - P	34	0	0	0	0	0	0	0	66	0	0
Lucent	22	0	0	1	0	22	44	9	0	1	1
Median Number of PRF											
Intel	1845	2234	2816	2962	2720	3350	3157	2817	2622	2331	1553
Link - P	168	168	168	169	168	168	168	168	168	169	168
Lucent	111	112	111	111	111	111	168	111	111	55	55
Median Dwell Time (seconds)											
Intel	2.65	3.85	9.79	6.30	23	167	15.3	6.66	17.1	9.14	6.42
Link - P	2.62	3.16	10.5	143	4.44	5.77	2.59	16.5	8.00	5.99	4.97
Lucent	0.51	10.6	0.53	1.26	2.78	62.4	1.66	0.86	4.69	5.92	0.08

In this chapter, we demonstrate how some of the parameters obtained from profiling active scanning algorithms can be used to distinguish WNICs. The ability to passively profile a WNIC and within the first few seconds or even less than that (when it starts scanning for APs), can be very useful to the field of wireless network security. As mentioned previously in chapter 1, this information can help us identify a rogue host from authenticated hosts. A point worth mentioning is that by using such a scheme, a WNIC can be identified in the shortest amount of time from the signature list of the WNICs previously profiled, as it has been demonstrated earlier [12, 13]. Practically speaking, a rogue host can be identified even before it starts communicating any application layer packets. Such kind of distinction between the hosts can be achieved at the MAC Layer, preventing the data to be sent or received from the higher TCP/IP layers.

We randomly choose three WNICs; Intel, Link-P and Lucent and use the parameters in Table - 3 to distinguish them. The results are quite interesting when various characterizing parameters are combined. We notice that the channel on which the 1st PRF is sent by the three WNICs to be very distinctive. For example, Intel was the only WNIC which also received the 1st PRF on channels 2 and 3. If an IDS is sniffing on these channels, it can clearly ascertain that the Intel WNIC has started scanning for APs. This parameter can act as a quickest method which can help distinguish WNICs. Such a distinction is hard to achieve if sniffing is limited to selective channels only [12, 13].

There are some channels which receive the 1st PRF for two or more WNICs. In such a case, we can look at the number of PRFs sent on those channels. Clearly the median value for number of PRF for Intel on all channels is too large. Compared to Link-P or Lucent. Even the values for Link-P are modestly always larger than the Lucent. We confirmed that the median values are good indicator by calculating the confidence of these median values, which were found to be particularly large. We observed that just by using two parameters we were able to pinpoint the WNIC used. A faster and guaranteed distinction can be achieved by looking at all the parameters which includes the burstiness, sequence of probing and dwell time. The theoretically possible identification of a WNIC can be achieved by examining the 1st PRF or waiting for the first few PRFs. Together with the dwell time, and looking at its burstiness, an IDS can act faster to find out the identity of the WNIC used by any attacker.

CHAPTER 8 – CONCLUSION

In this thesis report we have shown the importance of characterizing active scanning algorithms of various WNICs. We have shown how this information based on characterization can be of significant importance to several related fields, mainly wireless network security, link layer handovers, AP deployment, wireless network simulations, etc.

We have empirically proved that scanning does not always start on channel 1, is not sequential, and contains a significant amount of variation depending on the WNIC chipset and driver used. Also, we showed that there is no correlation between the channels where access points are commonly deployed (1, 6, and 11), and the channels that are favored by the scanning algorithms.

We further find that the number of PRFs sent per WNIC and on each channel were unique with channel 6 being the most popular for the majority of the WNICs. Intel sent the most probes overall and showed a bursty nature. We also show our discovery of the algorithm/ order of probing the channels for two WNICs, which is a parameter that can be used for further distinction.

Also, we showed that the dwell time for each WNIC on each channel is channel, WNIC and driver specific. Some WNICs had a significantly higher dwell time on particular channels because either they sent more PRFs on that channel or because the WNIC kept cycling back to these channels repeatedly.

Finally, we demonstrate how our approach can be used to effectively identify a rogue host in a wireless network. We empirically show this distinction between WNICs of various manufacturers and validate the efficacy of our approach, drawing comparisons with the previously known approaches.

CHAPTER 9 – FUTURE WORK

As a part of the proposed future work, we are currently attempting to further describe the active scanning algorithm, both quantitatively and qualitatively. Proposed future work can be broken down into the following: 1) we wish to decode the sequence of channels probed (algorithm) for the rest of the WNICs; 2) we wish to find the periodicity of these active scanning algorithms studying the temporal behavior using signal processing as a tool to provide a real time rogue host detection scheme; and 3) we wish to examine the behavior of the active scanning algorithm when associated with an AP.

Our initial finding show that some WNICs tend to associate with an AP even before the WNIC interface is brought up (using Linux tool *ifconfig*). Another finding is that after being associated with an AP, a WNIC only probes for an AP when the signal strength of the AP degrades below a certain threshold. The probing was also found to be less rigorous, compared to when it initially scans for an AP. We wish to further examine phenomenon like these and profile the behavior of active scanning algorithms in such conditions.

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APPENDIX A: RADIOTAP HEADER AND MONITOR MODE

This appendix contains the structure of the radiotap header and the fields in it. It also contains the snapshots of a typical trace file and the radiotap header using the *wireshark* utility. Another snapshot shows the output from the *iwconfig* tool from Linux, highlighting the details of the wireless interface in monitor mode.

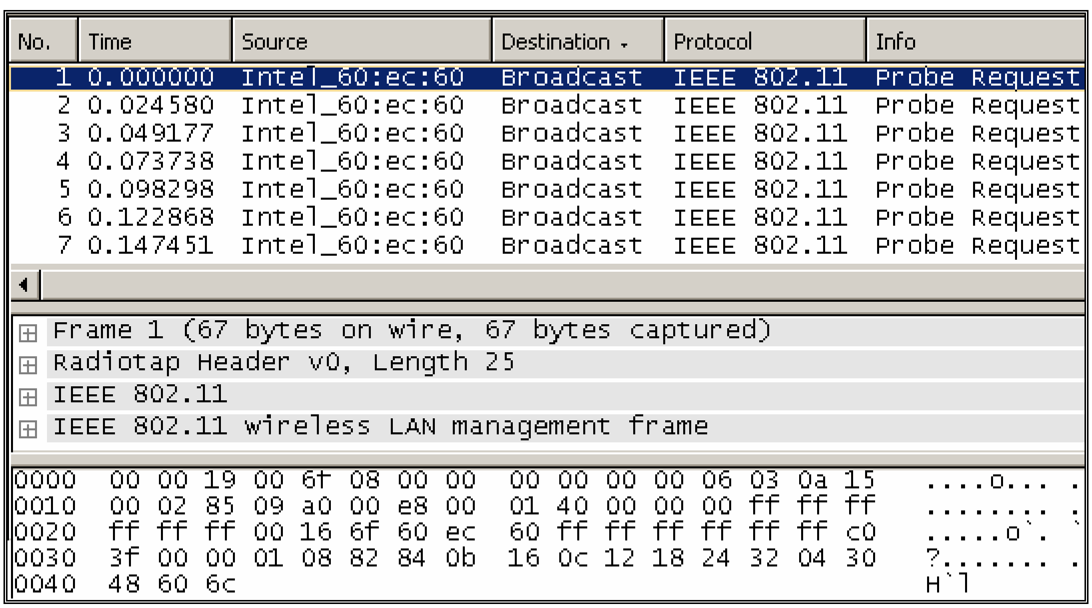
Radiotap Header Structure

```
struct ieee80211_radiotap_header {
        u_int8_t        it_version;     /* set to 0 */
        u_int8_t        it_pad;
        u_int16_t       it_len;         /* entire length */
        u_int32_t       it_present;     /* fields present */
} __attribute__((__packed__));
```

Supported list of radiotap header fields

```
enum ieee80211_radiotap_type {
        IEEE80211_RADIOTAP_TSFT = 0,
        IEEE80211_RADIOTAP_FLAGS = 1,
        IEEE80211_RADIOTAP_RATE = 2,
        IEEE80211_RADIOTAP_CHANNEL = 3,
        IEEE80211_RADIOTAP_FHSS = 4,
        IEEE80211_RADIOTAP_DBM_ANTSIGNAL = 5,
        IEEE80211_RADIOTAP_DBM_ANTNOISE = 6,
        IEEE80211_RADIOTAP_LOCK_QUALITY = 7,
        IEEE80211_RADIOTAP_TX_ATTENUATION = 8,
        IEEE80211_RADIOTAP_DB_TX_ATTENUATION = 9,
        IEEE80211_RADIOTAP_DBM_TX_POWER = 10,
        IEEE80211_RADIOTAP_ANTENNA = 11,
        IEEE80211_RADIOTAP_DB_ANTSIGNAL = 12,
        IEEE80211_RADIOTAP_DB_ANTNOISE = 13,
        IEEE80211_RADIOTAP_FCS = 14,
        IEEE80211_RADIOTAP_EXT = 31  };
```

Wireshark Snapshot for a typical capture trace



No.	Time	Source	Destination	Protocol	Info
1	0.000000	Intel_60:ec:60	Broadcast	IEEE 802.11	Probe Request
2	0.024580	Intel_60:ec:60	Broadcast	IEEE 802.11	Probe Request
3	0.049177	Intel_60:ec:60	Broadcast	IEEE 802.11	Probe Request
4	0.073738	Intel_60:ec:60	Broadcast	IEEE 802.11	Probe Request
5	0.098298	Intel_60:ec:60	Broadcast	IEEE 802.11	Probe Request
6	0.122868	Intel_60:ec:60	Broadcast	IEEE 802.11	Probe Request
7	0.147451	Intel_60:ec:60	Broadcast	IEEE 802.11	Probe Request

```
⊞ Frame 1 (67 bytes on wire, 67 bytes captured)
⊞ Radiotap Header v0, Length 25
⊞ IEEE 802.11
⊞ IEEE 802.11 wireless LAN management frame
```

```
0000  00 00 19 00 6f 08 00 00  00 00 00 00 06 03 0a 15   ....o... .
0010  00 02 85 09 a0 00 e8 00  01 40 00 00 00 ff ff ff   ........ .
0020  ff ff ff 00 16 6f 60 ec  60 ff ff ff ff ff ff c0   .....o`. `
0030  3f 00 00 01 08 82 84 0b  16 0c 12 18 24 32 04 30   ?....... .
0040  48 60 6c                                           H`l
```

Radiotap Header as viewed in *wireshark*

```
⊞ Frame 1 (67 bytes on wire, 67 bytes captured)
⊟ Radiotap Header v0, Length 25
    Header revision: 0
    Header pad: 0
    Header length: 25
    Present flags (0x0000086f)
    MAC timestamp: 1516027548868280320
    Preamble: Long (0)
    FCS: False (0)
    DATAPAD: False (0)
    Data Rate: 1.0 Mb/s
    Channel: 2437 (chan 6)
    Channel type: 802.11b (0x00a0)
    SSI Signal: -24 dBm
    SSI Noise: 0 dBm
    Antenna: 1
⊞ IEEE 802.11
⊞ IEEE 802.11 wireless LAN management frame

0000  00 00 19 00 6f 08 00 00  00 00 00 00 06 03 0a 15
0010  00 02 85 09 a0 00 e8 00  01 40 00 00 00 ff ff ff
0020  ff ff ff 00 16 6f 60 ec  60 ff ff ff ff ff ff c0
0030  3f 00 00 01 08 82 84 0b  16 0c 12 18 24 32 04 30
0040  48 60 6c
```

Tool *iwconfig* showing the eth1 interface in monitor mode on channel 5

```
[root@localhost ~]# iwconfig
eth1      unassociated  ESSID:off/any  Nickname:"localhost.localdomain"
          Mode:Monitor  Frequency=2.432 GHz  Access Point: 00:00:00:00:00:00
          Bit Rate:0 kb/s   Tx-Power=20 dBm   Sensitivity=8/0
          Retry limit:7   RTS thr:off   Fragment thr:off
          Encryption key:3671-A113-A0   Security mode:open
          Power Management:off
          Link Quality:0  Signal level:0  Noise level:0
          Rx invalid nwid:0  Rx invalid crypt:0  Rx invalid frag:0
          Tx excessive retries:0  Invalid misc:563   Missed beacon:0

rtap0     no wireless extensions.
```

APPENDIX B: CHANNELS RECEIVING THE 1ST PROBE REQUEST FRAME

This appendix shows the channels which receive the 1st probe request frame in a tabular format, specific to each wireless network interface card.

Channels Receiving the 1st Probe Request Frame

Channels	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	Total
Airlink	60	0	0	0	0	0	35	4	1	0	0	100
Dlink	66	0	0	0	0	0	0	0	34	0	0	100
Intel	2	11	7	8	0	0	17	25	13	17	0	100
Linksys - Prism	34	0	0	0	0	0	0	0	66	0	0	100
Linksys - HAP	2	8	3	4	0	1	72	6	3	1	0	100
Cisco	19	0	15	0	2	11	23	25	5	0	0	100
Lucent	22	0	0	1	0	22	44	9	0	1	1	100
Total	**205**	19	25	13	2	34	**191**	69	**122**	19	1	

APPENDIX C: NUMBER OF PROBE REQUEST FRAME STATISTICS

This appendix contains tables showing the total number, median and the average number of probes request frames on each channel, for all wireless network interface cards.

Statistics Showing the Total, Median and Average Number of Probe Request Frames

Channels	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	Total
Airlink	59071	62358	65548	73978	73547	97306	83029	73915	59304	44909	35490	728455
Median	591	641	641	739	739	986	839	739	591	443	345	
Average	590	623	655	739	735	973	830	739	593	449	354	
D-Link	16019	16075	16076	16043	16059	16016	16803	16811	16809	16874	16803	180388
Median	168	168	168	168	168	169	168	168	168	169	168	
Average	160	160	160	160	160	160	168	168	168	168	168	
Intel	182957	223889	280956	295488	271937	333421	315903	283513	263375	234131	152997	2838567
Median	1845	2234	2816	2962	2720	3350	3157	2817	2622	2331	1553	
Average	1829	2238	2809	2954	2719	3334	3159	2835	2633	2341	1529	
Link-P	16823	16821	16821	16868	16801	16788	16800	16800	16802	16893	16803	185020
Median	168	168	168	169	168	168	168	168	168	169	168	
Average	168	168	168	168	168	167	168	168	168	168	168	
Link-H	122675	110361	93225	106147	104636	127464	142452	131437	101000	73009	59860	1172266
Median	1223	1116	957	1063	1063	1276	1435	1329	1010	744	584	
Average	1226	1103	932	1061	1046	1274	1424	1314	1010	730	598	
Cisco	53661	80731	79352	86853	89737	103539	91753	102416	76529	65807	52120	882498
Median	547	821	767	876	876	1041	931	1041	766	657	547	
Average	536	807	793	868	897	1035	917	1024	765	658	521	
Lucent	11141	9593	11111	11135	11158	13467	16841	11157	11126	7381	5500	119610
Median	111	112	111	111	111	111	168	111	111	55	55	
Average	111	95	111	111	111	134	168	111	111	73	55	

APPENDIX D: DWELL TIME STATISTICS

The appendix shows the dwell time statistics for all the wireless network interface cards. Dwell time is the difference in the timestamps of two consecutive probe request frames. The two tables included show the total dwell time and the median dwell time for all 100 trials.

Total Dwell Time

Channels	1	2	3	4	5	6	7	8	9	10	11	Total
Airlink	307.39	640.73	1089.2	3534.1	4326.9	2058.3	2890.8	4166	2338.7	2201.6	157.78	23711.5
Dlink	196.12	403.21	872.16	6510	521.64	629	234.28	9849.2	751.92	615.11	536.45	21119.1
Intel	300.14	430.14	1088.2	718.26	1959	16259	1540.1	669	2176.4	3142	1698	29980.2
Link-P	268.92	308.56	985.39	12311	426.65	583.9	237.81	4373	719.78	607.2	473.32	21295.5
Link-H	689.52	696	223.61	752.25	1082.9	13143	1932.3	1507.1	561.29	2112.5	298.23	22998.7
Cisco	111.07	970.8	363.81	2414.3	479.03	8449	639.03	1819.7	231.07	6378.4	1825.6	23681.8
Lucent	472.78	1791.5	546.55	1792.9	1599.4	6412.9	1577.7	1050	2821.2	4521.4	109.96	22696.3

Median Dwell Time

Channels	1	2	3	4	5	6	7	8	9	10	11
Airlink	2.82	2.98	4.66	23.29	32.83	17.64	30.20	32.21	6.35	3.54	1.43
Dlink	1.91	4.07	8.27	56.79	5.27	5.89	2.28	102.50	7.88	5.99	5.47
Intel	2.65	3.85	9.79	6.30	23.02	167.61	15.36	6.66	17.17	9.14	6.42
Link-P	2.62	3.16	10.56	143.53	4.44	5.77	2.59	16.58	8.00	5.99	4.97
Link-H	6.38	5.53	1.73	7.97	3.92	140.68	12.65	9.39	3.60	7.36	1.25
Cisco	0.83	8.82	3.39	24.76	4.43	85.42	5.94	15.59	1.56	66.05	5.19
Lucent	0.51	10.66	0.53	1.26	2.78	62.45	1.66	0.86	4.69	5.92	0.08

APPENDIX E: NUMBER OF PROBE REQUEST FRAMES vs. CONFIDENCE

The following appendix shows the number of probe request frames and its confidence percentage. Confidence percentage describes the number of times, the same numbers of probe request frames are sent in 100 trials. We also show the average, maximum, minimum and standard deviation of the number of probe request frames across all the channels, for all the wireless network interface cards.

Percentage Confidence, Minimum, Maximum and Standard Deviation of Probe Request Frames

Airlink											
Channels	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %
	542 3	591 35	641 71	690 1	690 8	937 24	789 15	739 85	591 96	443 88	345 80
	591 92	627 1	690 11	739 89	739 70	938 3	790 2	740 15	642 4	493 3	394 10
	592 2	641 42	691 17	740 7	740 21	986 47	838 23			494 9	395 10
	606 1	642 22	700 1	758 1	757 1	987 26	839 60				
	641 1			789 1							
	642 1			790 1							
Average	**591**	**624**	**655**	**740**	**735**	**973**	**830**	**739**	**593**	**449**	**355**
Max	**642**	**642**	**700**	**790**	**757**	**987**	**839**	**740**	**642**	**494**	**395**
Min	**542**	**591**	**641**	**690**	**690**	**937**	**789**	**739**	**591**	**443**	**345**
St. Dev.	**11.25**	**24.07**	**22.79**	**8.88**	**13.60**	**21.98**	**18.73**	**0.36**	**10.04**	**16.58**	**19.90**

D-Link											
Channels	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %
	111 14	111 13	111 13	111 12	111 13	111 4	168 97	168 89	168 91	168 26	168 97
	168 84	168 86	168 84	112 2	168 87	112 11	169 3	169 11	169 9	169 74	169 3
	169 1	184 1	169 2	168 62		168 25					
	184 1		183 1	169 23		169 60					
				184 1							
Average	**160**	**161**	**161**	**160**	**161**	**160**	**168**	**168**	**168**	**169**	**168**
Max	**184**	**184**	**183**	**184**	**168**	**169**	**169**	**169**	**169**	**169**	**169**
Min	**111**	**111**	**111**	**111**	**111**	**111**	**168**	**168**	**168**	**168**	**168**
St. Dev.	**20.01**	**19.39**	**19.39**	**20.05**	**19.27**	**20.45**	**0.17**	**0.31**	**0.29**	**0.44**	**0.17**

Intel											
Channels	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %
	1796 17	2185 7	2622 1	2767 1	2476 1	3253 2	2722 1	2575 1	2428 1	2233 1	1457 1
	1797 17	2186 1	2719 1	2913 5	2574 1	3301 7	3059 2	2767 2	2477 1	2282 16	1505 47
	1843 1	2229 1	2767 7	2914 15	2622 1	3302 20	3107 2	2768 3	2524 1	2283 3	1553 16
	1844 3	2233 31	2768 6	2915 4	2671 10	3303 4	3108 12	2816 23	2525 5	2329 1	1554 23
	1845 47	2234 41	2815 1	2962 28	2672 2	3304 1	3109 3	2817 27	2573 3	2330 16	1555 13
	1846 13	2281 3	2816 50	2963 30	2718 2	3349 1	3155 4	2818 5	2574 2	2331 32	
	1893 1	2282 10	2817 27	2964 4	2719 13	3350 21	3156 17	2864 3	2621 2	2332 4	
	1895 1	2283 5	2818 2	2970 1	2720 42	3351 31	3157 24	2865 19	2622 35	2378 5	
		2284 1	2865 3	3010 2	2721 7	3352 11	3158 1	2866 6	2623 5	2379 6	
			2866 1	3011 6	2768 9	3400 2	3204 3	2867 2	2670 20	2381 1	
			2867 1	3012 4	2769 11		3205 18	2913 2	2671 17	2427 7	
					2770 1		3206 12	2914 5	2672 5	2428 5	
							3254 1	2915 2	2720 3	2429 2	
										2476 1	
Average	**1830**	**2239**	**2810**	**2955**	**2719**	**3334**	**3159**	**2835**	**2634**	**2341**	**1530**
Max	**1895**	**2284**	**2867**	**3012**	**2770**	**3400**	**3254**	**2915**	**2720**	**2476**	**1555**
Min	**1796**	**2185**	**2622**	**2767**	**2476**	**3253**	**2722**	**2575**	**2428**	**2233**	**1457**
St. Dev.	**24.82**	**24.81**	**29.45**	**34.45**	**41.28**	**27.12**	**58.18**	**44.09**	**49.39**	**47.51**	**25.53**

Link-P											
Channels	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %
	168 99	168 99	168 99	168 46	168 99	111 1	168 100	168 100	168 98	168 7	167 1
	191 1	189 1	189 1	169 53	169 1	168 54			169 2	169 93	168 95
				183 1		169 45					169 4
Average	**168**	**168**	**168**	**169**	**168**	**168**	**168**	**168**	**168**	**169**	**168**
Max	**191**	**189**	**189**	**183**	**169**	**169**	**168**	**168**	**169**	**169**	**169**
Min	**168**	**168**	**168**	**168**	**168**	**111**	**168**	**168**	**168**	**168**	**167**
St. Dev.	**2.30**	**2.10**	**2.10**	**1.53**	**0.10**	**5.77**	**0.00**	**0.00**	**0.14**	**0.26**	**0.22**

Link-H											
Channels	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %
	1169 2	1010 4	904 47	1010 4	1010 32	1223 4	1382 22	1276 25	957 5	691 29	584 74
	1223 88	1063 12	957 37	1063 89	1063 42	1276 73	1435 45	1277 3	1008 1	744 59	638 8
	1224 1	1064 4	958 16	1064 6	1064 25	1277 22	1436 32	1318 1	1010 78	745 11	639 17
	1276 4	1116 60		1116 1	1070 1	1330 1	1521 1	1329 42	1011 11	879 1	677 1
	1277 5	1117 19						1330 29	1052 1		
		1126 1							1063 2		
Average	**1227**	**1104**	**932**	**1061**	**1046**	**1275**	**1425**	**1314**	**1010**	**730**	**599**
Max	**1277**	**1126**	**958**	**1116**	**1070**	**1330**	**1521**	**1330**	**1064**	**879**	**677**
Min	**1169**	**1010**	**904**	**1010**	**1010**	**1223**	**1382**	**1276**	**957**	**691**	**584**
St. Dev.	**17.48**	**27.38**	**26.74**	**11.81**	**25.08**	**11.89**	**24.26**	**24.01**	**16.60**	**28.49**	**25.04**

Cisco											
Channels	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %
	492 19	766 18	766 34	821 14	876 59	985 6	822 1	877 1	658 1	601 1	492 43
	536 1	767 8	767 17	822 1	877 3	986 7	876 22	985 7	766 62	602 1	493 4
	547 65	821 29	821 16	875 1	931 6	987 1	877 1	986 20	767 37	656 5	494 1
	548 13	822 37	822 26	876 60	932 28	1040 21	931 51	987 1		657 86	547 12
	549 2	823 8	823 7	877 20	933 3	1041 47	932 24	1040 4		658 3	548 26
				878 3	941 1	1042 14	933 1	1041 37		711 1	549 14
				928 1		1095 1		1042 30		712 2	
						1096 1				713 1	
						1097 2					
Average	**537**	**807**	**794**	**869**	**897**	**1035**	**918**	**1024**	**765**	**658**	**521**
Max	**549**	**823**	**823**	**928**	**941**	**1097**	**933**	**1042**	**767**	**713**	**549**
Min	**492**	**766**	**766**	**821**	**876**	**985**	**822**	**877**	**658**	**601**	**492**
St. Dev.	**21.75**	**24.43**	**27.88**	**20.70**	**27.39**	**22.92**	**25.27**	**29.12**	**10.85**	**13.54**	**28.08**

Lucent											
Channels	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %	n %
	111 96	55 28	111 89	111 98	111 99	111 59	168 59	111 99	111 74	55 67	55 100
	112 3	111 18	112 11	112 1	169 1	168 11	169 41	168 1	112 26	112 33	
	149 1	112 53		145 1		169 30					
Average	**111**	**96**	**111**	**111**	**112**	**135**	**168**	**112**	**111**	**74**	**55**
Max	**149**	**119**	**112**	**145**	**169**	**169**	**169**	**168**	**112**	**112**	**55**
Min	**111**	**55**	**111**	**111**	**111**	**111**	**168**	**111**	**111**	**55**	**55**
St. Dev.	**3.80**	**25.67**	**0.31**	**3.40**	**5.80**	**28.54**	**0.49**	**5.70**	**0.44**	**26.94**	**0.00**

APPENDIX F: DWELL TIME ON EACH CHANNEL FOR ALL 100 TRIALS

This appendix shows the dwell time for each wireless network interface card on each of the 11 channels, for all the 100 trials.

Airlink											
Channel	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Trial-1	5.2223	3.4	1.7096	35.604	84.673	25.745	18.686	7.6349	44.643	8.657	1.1202
Trial-2	4.0094	2.0921	1.5342	23.946	50.083	18.512	31.829	17.256	75.35	8.2745	3.0494
Trial-3	4.911	2.6614	2.0273	31.945	95.688	28.206	15.385	9.9658	42.349	4.1193	1.2589
Trial-4	4.7744	3.9619	1.7015	35.313	105	37.647	12.519	6.1443	28.134	1.4951	1.4423
Trial-5	4.3808	3.2495	1.9451	11.333	84.556	42.203	19.078	15.465	52.286	1.3533	0.63589
Trial-6	4.0407	4.1247	1.2225	5.5115	120.42	67.145	7.6311	4.9963	17.6	2.7432	0.40973
Trial-7	4.4155	3.0576	1.1682	4.4258	95.789	52.848	15.531	16.312	37.571	2.7327	0.61014
Trial-8	4.5386	2.3972	4.2382	6.5619	108.89	58.814	11.391	7.3699	28.793	3.3461	0.55202
Trial-9	4.0129	1.4125	2.5899	2.1649	26.956	22.401	42.883	31.267	97.852	3.4784	1.2518
Trial-10	5.2747	1.2565	6.6873	7.036	114.42	58.718	13.466	6.6064	23.062	0.97283	0.56527
Trial-11	4.0517	1.6176	5.6652	13.879	108.29	50.482	16.529	8.0961	27.552	1.0355	0.65292
Trial-12	4.8168	1.2746	2.8782	37.502	124.19	35.438	7.0004	4.201	15.559	0.80594	0.7983
Trial-13	6.5114	1.9089	1.8677	35.463	123.05	37.991	8.1971	5.6876	13.286	1.8176	0.9114
Trial-14	4.4007	1.6013	2.1993	12.848	35.611	8.9214	36.786	26.109	102.2	5.5717	1.2373
Trial-15	5.0123	1.6958	3.0203	34.711	104.85	32.155	13.945	12.192	26.001	2.3701	1.1365
Trial-16	4.2502	1.9436	1.5227	44.386	129.53	36.179	4.9826	11.081	0.67803	1.5253	1.2093
Trial-17	4.3633	1.5531	6.0253	13.421	34.134	8.7635	34.206	120.24	6.2452	3.9905	5.3693
Trial-18	4.1649	1.0975	15.913	5.5322	26.006	10.321	35.067	122.94	7.2622	3.5526	1.553
Trial-19	3.8858	1.1787	5.4934	8.6223	30.028	7.8969	39.716	130.63	5.7885	4.0532	1.216
Trial-20	3.5583	0.93241	1.3944	7.3549	112.24	2.8007	19.325	83.777	3.7455	1.1668	2.2202
Trial-21	2.7093	2.2617	1.9683	18.524	135.29	3.6396	1.4706	68.202	1.5443	0.62803	1.4502
Trial-22	4.4405	1.1629	4.7677	32.613	83.966	23.256	18.55	58.819	3.2394	5.3782	1.7061
Trial-23	3.5006	0.76883	2.4263	21.443	42.1	9.8578	33.591	112.9	4.3064	2.1243	5.4905
Trial-24	1.9448	1.8022	1.1888	23.31	134.77	10.142	3.3031	52.962	2.714	3.4045	2.5472
Trial-25	2.8879	0.7907	1.6733	23.269	65.769	18.177	30.509	86.049	2.2781	3.5342	1.9543
Trial-26	2.6936	1.0375	1.0406	20.932	31.694	13.542	40.715	57.403	3.2418	61.755	1.7816
Trial-27	2.7941	0.84088	3.363	24.406	63.24	23.657	28.59	34.233	6.4608	47.284	1.9157
Trial-28	2.6744	1.2481	3.866	21.268	59.831	13.521	33.833	38.459	6.6247	55.806	1.8488
Trial-29	2.961	0.69394	5.8456	23.716	55.378	14.129	33.446	41.187	2.3584	55.817	1.7505
Trial-30	2.693	0.86344	3.5197	20.98	61.579	14.721	31.685	39.048	3.2425	54.048	1.6731
Trial-31	2.9413	1.3395	5.3929	27.756	75.564	22.197	25.05	31.79	2.7379	38.931	1.6457
Trial-32	3.5375	1.1751	8.7701	21.29	66.479	15.296	25.975	34.753	2.1154	56.195	1.5006
Trial-33	3.3444	0.45286	3.5816	21.57	62.139	14.806	32.811	40.48	3.5877	52.841	1.5543
Trial-34	2.8911	0.82884	2.1262	12.635	32.002	6.5865	42.441	56.409	4.3878	74.706	1.6943
Trial-35	2.8359	1.9487	3.2283	16.718	51.083	10.081	35.881	47.907	3.0183	62.852	1.7403
Trial-36	3.0239	5.8152	4.7197	23.553	58.381	16.483	26.411	41.481	3.0708	53.151	1.9268
Trial-37	2.8292	1.8336	4.6049	13.739	53.014	9.2567	34.887	47.964	3.3692	64.386	2.0211
Trial-38	2.6743	1.9185	3.9051	7.247	38.848	4.9707	40.536	57.039	4.6164	74.405	1.9619
Trial-39	2.5742	1.1987	2.8056	5.598	35.342	10.221	39.913	57.527	3.4562	75.653	2.1787
Trial-40	2.523	1.349	2.6924	5.2664	37.533	5.575	43.585	57.025	4.3385	75.136	2.6935
Trial-41	2.4853	2.8155	2.0766	36.851	7.9613	5.55	43.477	55.983	3.4457	74.776	2.0631
Trial-42	2.3016	0.79038	6.6874	38.524	5.2767	4.9817	44.168	54.38	4.1394	74.851	2.0233
Trial-43	2.1424	6.1662	9.1002	52.418	2.3693	13.588	35.092	47.099	3.5154	64.196	2.0088
Trial-44	1.5193	6.3575	10.191	55.898	2.5429	17.108	32.955	41.129	3.8657	64.157	2.1584
Trial-45	1.9816	2.6001	13.749	52.993	2.701	9.9273	30.103	50.054	4.3164	65.377	2.4685
Trial-46	2.2255	2.366	5.5371	26.85	2.3967	4.6185	44.059	53.563	4.6786	89.101	2.2944
Trial-47	2.1482	2.0175	3.97	26.952	2.9809	3.8286	47.806	60.468	4.5227	81.159	1.4458
Trial-48	2.1467	5.9127	4.1604	31.248	3.9728	4.982	43.173	57.506	5.0424	77.724	2.6392
Trial-49	2.2492	8.566	3.1042	41.428	5.2265	13.917	35.682	53.059	4.1777	67.476	2.3619
Trial-50	2.2092	6.9665	2.3616	40.84	5.9193	9.2985	38.616	52.336	4.3816	70.35	2.4182

Trial-51	2.0679	4.6354	3.0131	30.356	6.2194	3.7673	41.899	59.885	4.6303	78.296	2.5101
Trial-52	2.1254	6.0481	2.5554	23.388	7.1069	7.2291	43.28	59.45	5.4082	78.301	2.5968
Trial-53	3.317	6.5971	5.6603	39.872	7.664	16.081	32.622	20.822	37.977	64.556	2.675
Trial-54	3.1477	10.849	5.5526	73.988	9.2225	26.369	21.297	14.576	26.585	43.255	2.1484
Trial-55	4.0202	12.463	11.096	77.891	9.1061	23.865	21.145	11.892	24.274	39.631	2.0023
Trial-56	2.5375	16.259	4.1872	61.198	9.0608	17.066	30.291	14.542	26.251	53.797	1.8982
Trial-57	3.3291	19.723	9.3679	109.96	10.307	28.268	17.908	6.7714	9.1667	20.559	1.8704
Trial-58	3.6429	20.882	12.689	127.46	7.7263	37.475	4.6086	9.0305	0.57769	9.033	2.1561
Trial-59	3.4487	13.408	15.029	115.59	7.6697	33.422	9.2263	28.417	1.4261	7.6756	2.0185
Trial-60	2.6512	15.077	7.8447	89.045	6.9705	28.68	16.388	64.246	1.781	2.2575	1.6177
Trial-61	3.7775	19.529	10.663	104.69	6.7539	28.747	18.586	40.709	2.4161	1.387	1.2503
Trial-62	3.9789	14.461	8.447	119.08	6.7335	36.504	7.3445	32.639	1.9891	1.0896	1.1553
Trial-63	3.7629	11.263	11.905	86.626	5.9949	25.556	20.887	49.034	18.467	1.0109	3.0642
Trial-64	3.7479	15.894	10.598	115.85	4.711	36.363	12.723	7.9296	28.438	0.58936	0.84582
Trial-65	2.3306	11.906	7.6716	75.716	4.3777	23.893	28.935	20.273	60.793	1.0568	0.53701
Trial-66	3.0408	16.336	9.687	86.075	3.0069	24.324	20.919	17.249	54.642	1.2288	0.66199
Trial-67	5.1111	17.914	9.4403	124.43	4.3899	38.855	15.384	11.579	7.709	1.1118	1.179
Trial-68	1.9747	18.001	9.981	113.29	2.5333	34.652	41.341	2.8278	10.434	1.4206	1.4272
Trial-69	2.5301	15.532	12.193	128.41	1.6678	40.841	27.483	1.6818	3.2693	1.7061	1.3522
Trial-70	2.2955	24.724	9.7491	129.2	8.9948	30.305	23.523	2.494	3.2402	1.3775	0.97593
Trial-71	3.4373	14.701	16.151	108.64	7.4613	27.581	45.304	5.0951	6.7936	1.0445	1.1328
Trial-72	1.6147	1.4542	8.4965	32.933	2.9898	5.4691	110.86	10.585	59.195	1.2472	2.6339
Trial-73	1.7336	0.89985	2.6986	26.832	3.5054	4.425	70.098	10.522	108.83	4.7402	0.98182
Trial-74	2.0403	2.9871	1.4979	28.685	7.1565	6.4773	54.67	24.716	105.6	1.9764	0.28904
Trial-75	2.8189	1.589	3.6871	71.757	20.414	19.729	26.61	22.253	65.929	2.7764	0.44632
Trial-76	2.1399	1.5904	2.4251	10.857	44.583	17.097	40.866	27.333	88.031	1.7649	0.79285
Trial-77	3.5986	1.7791	4.5131	16.458	72.074	18.776	26.786	20.996	65.976	3.109	1.0947
Trial-78	2.3209	3.1858	4.4855	15.992	72.175	15.507	31.367	23.731	66.817	1.9783	0.93805
Trial-79	2.507	1.227	1.6812	5.4016	32.205	6.5382	46.329	34.235	103.9	2.9913	1.079
Trial-80	2.6219	2.11	4.8633	19.559	78.475	22.171	25.399	19.468	57.565	2.4375	1.1865
Trial-81	3.4467	2.6117	5.6836	22.992	86.501	21.169	22.565	17.709	51.279	2.2519	0.95683
Trial-82	1.9249	1.9111	1.3315	5.5674	34.034	3.6794	41.008	33.613	108.68	4.7636	0.98888
Trial-83	2.1543	4.4773	9.98	4.2558	49.304	10.129	40.795	26.233	84.15	3.2025	2.0408
Trial-84	3.5387	3.8457	11.835	4.6849	48.284	15.793	36.088	25.505	83.805	3.2179	1.037
Trial-85	2.8397	2.2675	12.667	4.1512	47.145	20.915	36.224	25.546	81.704	4.1064	1.0725
Trial-86	2.9685	5.0497	21.145	5.5097	93.398	20.794	22.388	23.978	35.353	2.451	2.2178
Trial-87	1.9263	5.7363	4.0403	1.0176	27.32	4.335	48.981	133.14	7.0665	4.1219	1.0252
Trial-88	2.583	13.417	5.1961	6.2786	69.09	19.434	30.718	83.241	4.9101	2.8291	0.91666
Trial-89	2.186	6.642	1.7585	4.3482	39.141	12.24	38.196	120.85	5.3231	3.8832	1.0592
Trial-90	2.719	5.3349	3.4742	5.0506	33.452	14.513	13.628	143.86	8.4099	6.746	0.4982
Trial-91	1.7081	11.68	2.4293	0.87863	26.012	5.9581	41.418	134.31	7.8315	4.3203	0.94238
Trial-92	2.5941	14.892	19.355	8.969	127.9	28.084	13.426	19.027	1.8494	1.4759	0.92489
Trial-93	2.6273	6.8245	27.554	8.4281	136.28	33.278	12.467	5.7853	1.9995	1.411	1.0519
Trial-94	3.3595	30.39	107.29	15.093	15.216	28.337	14.876	18.643	2.1173	1.3127	0.8833
Trial-95	1.8329	17.693	64.611	9.7462	1.8563	22.044	32.564	77.754	3.9193	2.0429	1.1905
Trial-96	2.2739	18.713	97.022	22.891	4.8173	30.157	18.799	37.707	2.7883	1.2335	1.0785
Trial-97	1.1704	18.922	35.308	10.507	1.407	11.417	12.912	131.94	8.875	2.8131	0.79095
Trial-98	2.7806	21.375	103.49	19.01	7.7788	36.028	16.177	26.022	2.4767	1.172	1.2152
Trial-99	2.2154	2.9828	9.3519	8.3415	2.3938	9.8627	47.335	140.89	7.5052	3.9924	1.3913
Trial-	2.3876	6.6364	114.6	29.71	4.5198	32.994	13.714	30.087	1.7764	0.61767	1.8674
Median	2.82	2.98	4.66	23.29	32.83	17.64	30.20	32.21	6.35	3.54	1.43

D-Link											
Channel	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Trial-1	1.8094	3.6447	8.8169	123.71	5.225	7.5529	2.0169	37.998	8.4633	6.1184	5.5502
Trial-2	3.2395	7.6454	14.703	69.821	6.8514	4.8027	2.0179	95.311	7.5439	6.5954	6.1493
Trial-3	2.5306	4.8125	9.3429	53.462	5.1735	6.7093	2.0405	104.56	7.7634	6.9952	5.4862
Trial-4	2.2572	4.6753	9.406	50.312	5.0029	9.1984	2.0276	106.07	7.7997	6.0238	5.4634
Trial-5	1.9034	7.9697	45.931	49.237	6.9403	4.8194	2.054	87.327	7.535	5.8828	5.6544
Trial-6	2.5786	4.4763	9.8904	57.609	5.227	6.7642	2.0958	100.02	8.0525	7.0715	5.3627
Trial-7	2.9013	4.9111	11.386	51.193	5.0812	8.0134	2.0953	103.39	7.5686	5.746	5.366
Trial-8	2.4617	4.2563	11.331	52.75	5.8425	7.1259	2.1043	103.79	7.4806	8.168	5.4142
Trial-9	2.8623	4.6237	10.817	54.45	5.4111	8.1075	2.0622	100.53	7.5577	6.771	5.5025
Trial-10	2.7103	5.0872	10.476	47.723	5.0233	6.1027	2.1011	109.98	7.6758	8.2129	5.5789
Trial-11	2.4561	4.9663	11.662	50.132	5.9213	5.9359	2.1513	105.07	7.6431	5.4974	5.5043
Trial-12	2.686	5.1604	12.322	55.628	5.0566	8.0367	2.156	98.367	7.6945	6.5898	5.3221
Trial-13	2.5369	4.9134	9.1853	60.482	5.162	10.42	2.1824	94.171	7.9179	5.437	5.5302
Trial-14	2.4716	4.2382	10.001	64.921	5.0108	6.5488	3.2394	93.435	7.9998	6.6542	5.6866
Trial-15	2.0194	4.5759	10.976	53.164	4.3935	6.3207	2.0835	104.5	8.2199	5.2607	5.641
Trial-16	2.3719	4.6463	11.564	56.914	5.8018	6.636	3.3133	98.944	8.0843	5.1116	5.4957
Trial-17	2.8699	3.8024	7.8313	120.12	5.0748	11.338	2.0805	40.808	8.7481	5.9803	5.7508
Trial-18	1.918	3.909	10.261	131.71	5.0638	7.1468	2.2769	30.503	8.8027	5.5194	5.7999
Trial-19	1.7001	3.9441	9.0427	91.343	4.8358	6.9522	2.2273	72.483	8.3135	5.3444	5.6655
Trial-20	1.9113	3.95	8.601	89.802	4.849	6.6151	2.3975	70.733	8.6863	5.2825	6.4552
Trial-21	1.927	4.2055	8.0606	65.848	4.7705	9.3428	2.4679	94.768	8.5262	6.367	5.8874
Trial-22	1.9583	4.3731	8.6257	82.555	4.6859	10.243	2.5636	78.243	8.582	5.4235	6.0975
Trial-23	1.9781	4.2578	7.9674	93.536	4.2508	5.7677	2.4887	69.627	8.0982	6.8005	5.2817
Trial-24	1.7368	4.2394	8.3182	128.41	4.3445	6.9444	2.639	33.243	8.5007	6.3103	4.7345
Trial-25	1.942	4.255	8.3793	51.771	4.71	6.9291	2.6439	109.11	8.2153	5.8852	5.367
Trial-26	1.9145	4.189	8.6054	118.49	4.7338	5.7171	2.7041	42.855	8.2032	5.1745	5.4175
Trial-27	1.8533	4.116	8.7731	117.38	4.6818	5.8284	2.4759	45.121	8.1171	5.406	5.2169
Trial-28	1.4933	3.5984	9.4465	130.92	3.7052	6.6992	2.1729	34.471	7.8857	5.319	4.9025
Trial-29	1.8126	4.2397	9.3481	79.02	4.8925	5.5462	2.452	81.714	8.588	5.593	5.3104
Trial-30	1.8678	4.198	8.218	59.979	4.9683	5.6392	2.5147	101.89	8.0021	5.3472	5.2944
Trial-31	1.8046	4.163	7.8991	34.813	4.9645	5.4454	2.5999	127.92	7.5224	6.3822	6.4424
Trial-32	1.8208	4.1345	7.9926	104.84	5.1349	6.816	2.6062	56.979	8.2692	5.4993	5.2872
Trial-33	1.7591	4.1973	10.614	120.12	5.1273	5.5862	2.5459	42.081	8.323	5.4824	4.9622
Trial-34	1.7488	4.0766	8.0736	58.725	5.2611	5.3847	3.0243	103.11	8.2922	5.3967	5.0649
Trial-35	1.7107	4.1529	8.0289	70.26	5.1836	6.872	2.4264	91.235	8.493	5.5682	5.7402
Trial-36	1.6814	4.2373	7.5599	79.124	4.9872	9.1408	2.4173	85.057	7.7445	5.8783	4.7711
Trial-37	1.666	4.2146	8.0402	71.591	5.2342	7.513	2.3668	89.142	8.6873	15.256	5.7277
Trial-38	1.6807	4.3641	8.4011	56.627	5.1624	8.0651	2.2773	105.55	8.2475	7.5678	5.3272
Trial-39	1.7002	4.351	8.1081	87.846	5.1997	6.055	2.1975	74.014	8.119	6.4035	5.3525
Trial-40	1.709	4.3671	7.8985	16.137	5.2789	5.0419	2.1062	146.66	7.8123	8.063	6.4773
Trial-41	1.7149	4.4073	8.2815	50.287	5.3213	5.7631	1.9554	111.39	8.1539	8.996	6.066
Trial-42	1.7262	4.3872	7.5873	70.171	5.309	7.1135	1.8454	91.219	7.8719	6.6485	5.6968
Trial-43	1.7327	4.3553	6.691	44.621	5.0313	6.1916	1.7362	131.68	3.5611	3.4545	3.4909
Trial-44	1.7642	4.3747	6.5734	26.23	5.3963	7.801	2.6708	137.29	7.5553	6.1287	5.8468
Trial-45	1.7971	4.0277	6.5934	43.653	5.0834	5.3269	1.4498	121.54	6.8986	6.0052	5.8895
Trial-46	1.8682	3.7925	4.2284	45.411	4.4313	7.6542	1.4234	127.5	5.3511	5.3602	5.7494
Trial-47	1.8079	4.3847	7.3203	38.174	5.3434	5.3309	1.3979	128.45	7.7208	6.3115	6.1204
Trial-48	1.8034	4.4578	9.2845	80.209	5.4628	5.245	1.9628	80.243	7.7512	7.2785	5.9985
Trial-49	1.7925	4.458	7.5961	24.108	5.5103	6.3442	1.3506	137.63	7.2298	7.615	6.1691
Trial-50	1.7971	4.3676	7.4688	67.739	5.4739	6.9916	1.3932	94.056	8.2163	6.704	6.3663

Trial-51	1.7905	4.2799	8.5581	49.719	5.5997	5.3051	1.4743	111.01	7.9519	7.9474	6.1553
Trial-52	1.7972	4.1616	8.5587	47.039	5.7658	5.2796	1.4566	113.48	8.256	7.7761	6.1745
Trial-53	1.8116	4.1406	7.9524	38.33	5.5967	5.4159	1.5195	126.67	8.0478	6.091	6.7418
Trial-54	1.4713	3.4499	8.0638	152.19	5.5842	7.1052	1.4463	11.075	8.5544	5.9282	4.9709
Trial-55	1.8366	4.0583	8.5899	79.42	5.6001	8.8873	1.6468	82.622	8.2327	6.2078	6.1645
Trial-56	1.8586	4.0734	7.6492	17.812	5.7734	8.9609	1.6382	145.89	7.1695	7.1148	5.7776
Trial-57	1.8737	3.9084	6.0325	105.48	3.5627	5.1414	1.6277	68.06	6.5184	4.7496	3.3889
Trial-58	1.856	3.6476	6.8716	88.108	5.0116	4.6226	1.7673	79.272	7.1257	5.5001	4.9335
Trial-59	1.9033	4.0214	11.131	153.51	4.7063	5.5436	1.7633	16.845	7.7014	4.3673	3.5676
Trial-60	1.5452	1.8274	6.1358	78.936	5.4392	8.0603	1.5131	99.449	4.0777	4.4867	2.3921
Trial-61	1.9392	3.8496	8.8722	39.553	5.6607	5.2971	1.9473	121.85	7.8531	7.2353	5.6839
Trial-62	1.9736	3.8329	5.5214	12.924	5.2452	5.3097	2.4174	157.05	5.9895	6.0829	5.2102
Trial-63	1.9975	3.8775	5.6327	12.174	4.936	7.4015	2.0703	158.73	5.4711	5.2039	4.9491
Trial-64	2.0035	3.6706	7.8251	57.935	5.4534	5.7314	1.9408	104.54	8.5093	8.5966	5.3194
Trial-65	2.0128	3.7756	8.2054	13.014	5.7674	5.6342	1.9875	148.28	8.6673	6.4611	6.2286
Trial-66	1.7174	3.3326	9.6956	78.161	5.1952	4.5151	2.0315	89.885	6.708	5.3379	4.4942
Trial-67	1.9931	3.882	9.4759	96.346	5.6257	7.8277	2.1137	65.783	8.6953	5.7835	5.7389
Trial-68	1.8157	3.5656	7.8922	56.66	5.4828	5.8984	2.2009	106.85	8.437	6.1022	4.9062
Trial-69	1.982	3.1291	3.6141	91.194	3.0364	3.7338	1.9914	88.446	5.0501	4.6557	4.3035
Trial-70	1.9286	3.5137	4.2158	59.855	4.5395	4.8547	2.1865	114.11	5.9871	4.7307	5.1922
Trial-71	1.9822	3.728	7.2492	23.502	5.3696	5.0512	2.3833	144.76	7.2647	4.781	5.2407
Trial-72	1.8647	3.3693	7.2693	93.233	4.4404	6.5331	2.5297	77.162	6.032	4.169	3.2469
Trial-73	2.0119	3.4925	7.2099	10.448	5.5358	5.4197	2.6609	153.97	6.8625	7.4218	7.522
Trial-74	2.0274	3.4589	6.503	10.453	5.4743	4.4179	2.6638	156.01	6.966	6.4535	5.3797
Trial-75	2.0452	3.3296	10.83	153.02	3.5153	4.3544	2.7666	14.34	7.9505	4.6685	3.0766
Trial-76	1.71	2.5965	7.1449	55.147	5.4895	6.4631	2.7506	112.98	5.9374	5.1301	4.3185
Trial-77	2.0085	3.4551	8.016	54.178	5.5874	5.6942	2.8256	107.5	8.8129	6.6113	5.4866
Trial-78	1.8541	3.2726	8.6694	131.59	4.5595	5.2012	2.8681	36.314	7.2434	4.8517	3.5153
Trial-79	2.0334	3.3088	8.4902	33.146	5.6055	5.8031	2.8157	133.73	6.2397	5.1484	5.5568
Trial-80	1.7279	2.6339	6.8952	90.008	5.5144	7.4293	2.2357	80.371	5.535	4.2889	5.4342
Trial-81	2.0276	3.3904	10.514	75.513	5.6019	5.8866	2.8806	86.254	7.4905	6.1968	5.8562
Trial-82	2.0172	3.3761	7.8898	55.473	5.7967	7.4583	2.938	104.56	7.9399	7.3117	5.8733
Trial-83	2.0052	3.3369	5.6805	3.7209	5.7485	4.6599	2.978	163.83	4.9392	4.8478	5.4618
Trial-84	1.9894	3.4304	6.1876	5.9698	5.6028	5.6537	3.0683	160.33	4.7631	5.9833	5.5215
Trial-85	1.1934	1.9279	4.4459	103.55	5.5894	4.4896	2.5297	75.178	4.166	2.983	5.0345
Trial-86	1.9893	3.5409	8.688	30.055	5.6601	5.9421	3.1719	132.69	7.6613	8.49	5.5954
Trial-87	1.934	3.4877	8.2852	18.211	5.744	5.8073	3.1194	145.13	6.98	5.903	5.4589
Trial-88	1.9136	3.5354	10.013	53.241	5.6617	5.9293	3.0712	111.45	8.3854	6.8503	5.607
Trial-89	1.9091	3.6661	8.2496	28.858	5.6724	7.0444	3.0305	130.77	8.3765	8.176	6.3714
Trial-90	1.9308	3.6218	6.2502	10.451	5.5255	4.4311	2.9898	155.11	6.3974	7.5142	5.4102
Trial-91	1.9495	3.7527	8.4758	32.429	5.7621	5.375	2.9497	130.18	6.8242	6.0947	5.8152
Trial-92	1.9423	3.9284	8.1343	15.457	5.6118	5.7304	3.0289	144.79	8.1105	7.8221	5.4543
Trial-93	1.9147	4.0489	8.8137	52.551	5.6423	5.8031	3.0827	107.54	8.6759	9.3069	5.4025
Trial-94	1.8973	4.1018	8.0573	33.046	5.6063	5.5294	3.2161	126.26	8.763	7.0328	5.397
Trial-95	1.9234	3.7441	5.9537	46.121	5.0761	3.8508	3.1511	128.97	3.5365	6.5699	4.5629
Trial-96	1.0655	2.5306	9.3991	172.2	4.4322	7.116	1.7989	1.7158	7.7469	2.8026	2.4577
Trial-97	1.8769	3.8454	8.4701	99.808	5.4448	4.2388	3.0293	64.856	7.8801	5.7089	5.1117
Trial-98	1.9268	4.4126	9.6115	89.115	5.0003	4.1094	3.1013	76.526	8.442	4.3961	4.9958
Trial-99	1.9289	4.3826	7.5009	21.173	5.4929	5.5485	3.1277	144.27	8.0322	4.8616	5.7502
Trial-	2.6498	5.3576	9.2383	76.947	5.7114	4.0129	3.1721	99.943	8.869	4.4859	5.8062
Median	1.91	4.07	8.27	56.79	5.27	5.89	2.28	102.50	7.88	5.99	5.47

Intel											
Channel	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Trial-1	1.7135	3.029	15.298	3.7541	4.3243	163.58	18.458	11.543	69.436	4.7118	3.9497
Trial-2	1.4587	3.4347	15.495	4.8146	5.2093	187.39	15.384	11.192	50.64	3.2203	1.8799
Trial-3	1.6554	3.6115	14.199	8.3855	8.1889	180.92	17.693	8.0107	52.558	1.977	2.9409
Trial-4	2.4298	3.665	4.6775	15.521	6.2736	183.89	14.259	8.041	50.699	6.5701	3.1896
Trial-5	2.7923	3.2689	3.5337	16.973	7.4991	181.78	14.193	8.3985	50.174	8.4752	1.996
Trial-6	3.1041	3.4457	4.482	16.515	6.929	181.56	14.902	9.0186	50.368	7.7396	1.1446
Trial-7	2.9973	4.0334	4.5314	15.509	6.099	183.62	15.032	8.9443	49.406	9.5177	0.62203
Trial-8	3.092	4.5546	4.6589	15.081	6.2681	182.88	14.882	9.0317	43.547	5.1238	10.281
Trial-9	2.6815	5.0379	4.4111	15.529	7.4316	181.13	15.374	8.4876	15.803	4.8668	38.445
Trial-10	1.5883	5.314	4.6189	15.797	6.7454	181.73	14.987	7.6986	16.724	5.5279	38.304
Trial-11	1.2505	4.8254	15.045	6.225	7.2657	180.85	14.727	6.0383	19.661	4.2117	39.785
Trial-12	2.2404	2.3428	19.2	6.0664	7.6421	178.24	14.084	6.7369	20.708	3.9146	38.046
Trial-13	1.8675	1.8873	19.105	6.8242	7.2756	178.39	15.096	6.8017	22.158	3.0697	36.933
Trial-14	2.1604	2.5973	20.298	7.3623	9.1233	174.34	15.263	6.2011	22.518	3.4593	36.073
Trial-15	2.4006	3.0114	18.119	7.3492	8.6531	198.29	14.874	5.9997	23.744	3.8996	13.935
Trial-16	1.6314	4.4153	22.094	5.8979	6.6787	174.77	15.468	6.6619	23.387	4.1577	34.185
Trial-17	14.39	4.5988	9.6482	6.9126	7.197	172.74	16.443	6.0337	22.447	4.4405	34.476
Trial-18	16.378	4.6089	9.6236	7.2305	7.2637	170.52	15.963	5.4383	24.236	5.0326	33.077
Trial-19	3.9684	4.8351	20.219	6.4363	8.7893	170.95	16.066	5.8114	23.58	5.2905	33.44
Trial-20	1.5151	4.742	21.558	8.2548	8.7597	170	16.373	6.2694	23.262	4.9394	33.606
Trial-21	1.6246	2.7311	21.387	8.1302	10.141	171.12	15.198	7.6988	25.009	4.5572	32.602
Trial-22	2.3468	1.9113	19.055	8.3687	10.444	173.93	15.418	7.4737	24.357	4.4985	32.509
Trial-23	3.0965	3.057	18.086	5.9725	11.263	173.59	15.976	8.3844	23.692	3.831	32.776
Trial-24	3.6492	3.8653	17.658	6.6908	10.932	172.4	14.944	8.3415	23.896	4.105	33.429
Trial-25	1.4316	4.5336	16.799	7.6515	10.022	175.6	15.03	8.8678	20.944	3.5136	36.062
Trial-26	1.6893	5.9611	15.514	7.9507	10.476	175	14.442	8.5034	20.795	4.1739	35.892
Trial-27	4.1416	4.2329	15.641	5.0264	14.08	173.15	14.629	8.5482	19.38	4.4246	37.167
Trial-28	1.7831	3.7754	14.932	7.5636	12.62	175.56	16.073	8.0857	18.03	4.3536	37.572
Trial-29	2.4514	2.5308	15.642	8.2615	13.559	171.79	15.365	8.3072	25.802	4.8246	30.398
Trial-30	1.3721	1.4524	15.468	8.1951	15.062	174.27	15.359	8.477	53.171	3.9511	3.461
Trial-31	0.7976	1.5567	15.975	7.5776	17.154	171.69	14.815	9.1705	49.512	4.2346	7.4123
Trial-32	1.6395	1.6529	15.551	7.5212	18.831	170.42	15.772	8.8187	48.878	4.9814	6.4442
Trial-33	1.7322	1.9523	15.601	8.9436	20.15	167.08	15.223	8.9175	37.809	4.5811	18.038
Trial-34	1.386	1.492	18.299	6.543	20.385	165.92	14.918	8.9457	52.54	7.4646	2.3347
Trial-35	1.2395	1.6734	18.334	6.1109	20.936	166.72	14.58	8.639	51.664	8.8144	1.772
Trial-36	1.3069	1.7738	16.283	5.8584	23.313	165.88	14.343	8.5267	52.434	8.2982	1.2767
Trial-37	1.5068	1.8241	16.849	6.8865	22.841	164.06	14.329	8.3976	52.125	8.6494	0.90566
Trial-38	1.4762	1.5521	16.106	7.1505	24.147	164.11	14.539	9.1984	54.748	6.4422	1.0584
Trial-39	1.4888	1.2789	14.673	8.4057	25.926	161.16	14.685	8.7667	54.483	6.1992	1.1913
Trial-40	1.3899	1.7111	14.11	12.119	25.475	158.79	15.078	8.3228	55.057	6.8976	0.9041
Trial-41	1.1228	2.9519	12.104	11.215	25.696	162.83	13.047	8.322	53.938	9.4581	0.59667
Trial-42	1.0634	4.0211	11.548	11.282	24.82	161.25	14.034	7.9042	10.489	52.243	0.60709
Trial-43	1.744	4.0982	12.83	9.8578	24.31	161.1	14.053	7.8037	8.8695	29.92	24.6
Trial-44	2.5385	4.08	11.432	8.8285	25.527	161.14	14.351	7.4589	8.3824	13.3	42.296
Trial-45	3.3038	3.8313	13.057	7.5886	26.2	160	15.025	6.3143	8.4745	13.218	43.129
Trial-46	3.8846	4.1195	11.404	8.419	26.846	158.87	14.374	6.0901	9.6136	13.399	42.307
Trial-47	3.0119	4.2745	11.001	6.9492	27.292	162.16	14.549	6.653	8.6657	13.944	41.948
Trial-48	1.5399	4.0459	8.3268	10.587	27.513	161.29	16.123	5.6129	17.623	5.2951	41.374
Trial-49	1.0114	3.2603	7.4238	9.8543	27.505	164.88	16.205	5.5174	19.966	3.6723	41.226
Trial-50	4.8966	1.9777	6.6324	6.5031	27.213	165.79	16.381	5.0037	21.574	4.2522	39.951

Trial-51	5.065	0.99138	6.8786	6.2433	28.497	164.63	16.382	4.3912	19.903	5.0467	41.066
Trial-52	2.5704	1.8533	6.1579	8.3026	27.323	166.3	15.87	4.3179	22.596	4.3629	39.654
Trial-53	1.3904	3.718	5.4059	9.439	27.448	166.08	16.856	4.2736	22.965	3.735	38.772
Trial-54	2.6942	3.4708	5.363	9.3205	27.043	165.34	16.977	3.4666	21.36	4.8375	39.463
Trial-55	3.6203	3.2981	5.7995	8.5183	25.402	166.85	16.053	3.7544	21.9	4.8382	39.38
Trial-56	4.3462	3.1385	6.7615	8.579	23.441	166.59	16.876	4.6554	21.999	4.6323	38.324
Trial-57	4.4801	3.7721	7.4243	7.8921	22.557	168.63	17.372	4.6971	19.954	4.4211	39.081
Trial-58	4.7649	3.2344	7.3425	7.3754	22.916	168.61	17.422	4.3267	20.2	4.0134	39.865
Trial-59	5.1459	3.1067	8.399	5.8003	22.941	168.42	18.262	3.9253	11.631	10.764	41.737
Trial-60	5.2001	3.0774	9.8447	5.4263	23.105	166.19	19.499	4.8655	8.9	13.148	40.845
Trial-61	5.6236	3.1792	11.105	3.8298	22.91	166.64	16.958	5.9348	8.7387	50.82	4.4184
Trial-62	6.3389	3.2544	9.1051	4.7379	21.754	168.83	16.776	5.8562	9.9707	52.85	1.0857
Trial-63	5.6687	3.9519	10.138	3.6472	23.309	167.41	15.656	6.5072	7.3925	54.937	1.7172
Trial-64	4.519	4.3458	10.078	3.3323	22.587	169.08	17.406	5.6945	7.6069	54.516	1.2449
Trial-65	3.9828	4.1961	10.031	6.6235	22.632	166.19	17.552	5.1423	8.9151	53.084	1.9274
Trial-66	3.5256	3.6104	10.657	6.348	22.551	166.37	16.784	5.293	7.6825	54.854	2.5795
Trial-67	3.0243	3.2545	10.428	4.9099	23.482	168.47	16.57	4.6639	9.0035	54.919	1.2309
Trial-68	3.3534	2.5731	10.199	5.1752	24.008	193.17	16.324	4.2436	8.9617	29.315	1.8689
Trial-69	3.1166	2.1781	8.9235	5.0697	24.495	167.72	17.575	3.6194	9.0081	53.702	3.7674
Trial-70	2.0005	2.0051	9.343	5.2746	24.497	169.08	14.455	5.3537	6.9107	56.146	3.412
Trial-71	1.9346	2.115	9.148	5.2292	25.084	169.63	10.791	9.4071	8.105	54.7	3.9926
Trial-72	1.0925	3.0672	9.4347	5.1068	25.228	169.16	11.428	8.9271	8.1917	53.519	4.812
Trial-73	0.90406	3.6962	10.256	5.0282	24.803	168.02	10.462	8.524	9.3263	52.772	5.0645
Trial-74	2.5099	4.1921	9.0969	4.512	24.576	168.39	11.164	7.3244	10.411	52.067	5.6154
Trial-75	2.2104	4.91	7.4316	5.2934	23.974	168.48	10.733	8.9693	9.2659	52.096	5.6767
Trial-76	2.5699	5.5681	6.7802	5.0378	25.339	167.73	10.302	8.8466	9.6855	51.681	5.8001
Trial-77	3.2451	6.2901	6.1281	4.1923	24.616	167.98	11.126	8.7303	10.799	49.866	6.2464
Trial-78	2.9028	6.7295	5.5508	4.9994	24.861	168.21	11.188	8.2531	9.4041	51.277	5.8147
Trial-79	3.7464	7.2894	5.6068	4.5182	25.015	167.49	12.323	9.1198	9.8953	49.451	6.1153
Trial-80	3.3947	7.4149	5.6056	5.0043	25.233	166.6	10.964	8.5274	9.7435	50.352	6.4014
Trial-81	3.3922	7.248	5.3231	5.1912	25.186	166.77	13.835	5.6694	12.207	48.424	6.9369
Trial-82	3.4898	7.2538	5.0964	5.9164	26.807	164.62	16.325	3.641	10.082	49.246	6.9245
Trial-83	3.524	7.3086	5.5105	5.5817	27.758	163.9	17.585	4.2149	9.7151	48.054	7.129
Trial-84	3.6171	7.2854	5.2303	5.566	27.47	162.29	18.151	3.7488	9.9853	49.24	6.5006
Trial-85	3.9218	7.5823	6.3263	5.2476	30.736	159.7	18.514	4.6529	8.5825	48.928	6.1888
Trial-86	3.2385	7.7731	6.4033	5.0099	29.375	160.34	18.051	6.0286	8.177	47.939	7.0837
Trial-87	3.5472	7.8211	6.9231	5.3588	30.091	158.78	18.014	6.1717	8.428	47.833	6.5004
Trial-88	3.6393	8.1342	7.2074	5.9513	28.726	159.06	18.323	6.6738	9.4168	46.827	6.0262
Trial-89	3.7737	7.8093	6.7746	5.2864	27.216	162.61	19.807	6.3612	8.4864	46.85	6.0942
Trial-90	3.7455	7.9632	8.0772	5.4321	16.603	170.59	19.262	5.0137	8.6761	48.565	5.5003
Trial-91	3.5381	8.061	8.3292	5.1722	28.377	158.38	18.424	4.5876	8.8137	50.37	5.2407
Trial-92	3.1731	7.9754	7.2137	5.5045	16.119	175.82	17.663	4.3174	9.3324	47.556	4.6762
Trial-93	2.7439	7.8942	7.4056	5.1656	9.5708	92.385	15.283	3.2767	9.471	139.2	7.8886
Trial-94	2.7971	8.2728	9.7262	5.728	27.72	71.279	13.883	7.1838	11.647	138.08	3.9153
Trial-95	2.5868	7.7603	7.8709	5.5038	29.964	70.6	16.929	4.172	12.646	137.05	5.5799
Trial-96	2.6281	7.387	8.1747	4.8449	29.25	71.963	16.302	3.3485	11.171	140.26	4.8571
Trial-97	2.4566	7.7897	9.2747	4.5087	23.861	75.825	16.06	3.7801	11.42	140.22	3.8933
Trial-98	2.4354	6.9849	10.305	4.9225	20.521	78.089	15.105	3.5394	9.2718	144.97	4.5222
Trial-99	2.014	7.2256	11.263	4.7368	14.917	84.11	14.92	3.6752	9.4667	144.72	4.0031
Trial-	1.9524	6.6894	12.782	4.4156	12.808	110.68	11.182	7.902	11.992	117.32	4.029
Median	2.65	3.85	9.79	6.30	23.02	167.61	15.36	6.66	17.17	9.14	6.42

Link-P											
Channel	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Trial-1	4.1916	2.6015	10.554	117.75	4.0591	6.7515	1.2182	42.701	8.7469	5.6256	6.8006
Trial-2	4.377	2.8388	9.3432	139.59	3.8824	8.1971	1.2094	20.428	8.3932	6.9154	6.8371
Trial-3	4.5885	2.9526	11.634	142.75	3.6982	6.5028	1.188	16.535	8.4406	6.885	6.7884
Trial-4	4.7685	3.1441	8.8505	97.205	3.497	7.5001	1.1646	62.662	8.4766	8.3691	6.8239
Trial-5	4.8454	3.2277	10.318	114.98	3.4379	6.3971	1.1489	44.452	8.4265	6.9167	6.8576
Trial-6	5.0077	3.0899	10.713	101.06	3.5112	5.9558	1.1063	58.799	8.438	7.1541	6.9089
Trial-7	5.33	5.0435	18.394	103.94	6.2261	3.968	1.0575	64.691	8.0961	7.2008	6.6331
Trial-8	5.3448	3.1625	10.093	94.916	3.434	7.0798	1.0612	65.765	8.3984	6.7105	6.9786
Trial-9	5.4573	2.9531	12.539	153.57	3.3752	5.6271	1.222	5.8603	8.3966	5.9614	6.9885
Trial-10	5.3618	2.9051	4.1657	150.9	0.96108	0.82614	1.0744	40.818	2.9664	2.7692	4.0207
Trial-11	5.5187	3.0158	9.0173	143.31	3.3172	8.2541	1.1338	15.769	8.4819	7.0262	7.2144
Trial-12	5.5182	3.1203	10.657	129.23	3.3091	10.637	1.0513	30.492	8.3665	6.3939	6.8988
Trial-13	5.5105	3.1235	8.9004	102.57	3.2496	7.722	1.1038	56.643	8.4846	9.5288	6.7899
Trial-14	5.4438	3.1041	12.895	129.89	3.3088	5.8196	1.3842	30.712	8.5677	5.7557	6.504
Trial-15	5.334	3.0253	10.562	90.786	3.3412	5.7769	1.6066	68.571	8.3829	7.0712	6.8049
Trial-16	2.8771	1.8901	12.98	162.35	3.33	5.7677	1.6623	4.5426	8.4135	4.8418	3.2553
Trial-17	5.1695	3.1913	9.5592	91.102	3.2184	7.4767	1.9355	68.293	8.3858	6.8508	5.9733
Trial-18	4.7006	3.1674	11.485	164.89	2.4371	8.0505	1.2933	4.4101	8.5404	3.9199	2.7041
Trial-19	4.6909	3.2093	13.066	152.63	3.457	5.8057	2.2244	6.9668	8.433	5.7666	5.7244
Trial-20	4.3698	3.2459	13.475	142.14	3.6687	5.635	2.4766	17.942	8.6446	7.0002	5.4629
Trial-21	4.2611	3.3583	16.276	148.26	3.7183	5.6626	2.6627	12.459	8.5898	6.1445	5.4752
Trial-22	3.5769	3.2136	11.107	157.06	3.9515	5.3408	2.4484	5.5259	8.3687	5.1573	4.7641
Trial-23	3.8078	3.4641	10.906	142.3	4.1324	6.7284	2.9389	17.594	8.6147	6.8414	5.7369
Trial-24	3.634	3.3906	11.803	124.95	4.2356	5.4994	3.0606	35.844	8.6454	6.3235	5.2197
Trial-25	3.5622	3.5233	11.72	156.85	4.1633	8.7059	2.9292	3.7805	8.6447	6.4239	5.038
Trial-26	3.4058	3.4866	13.515	119.56	4.4379	5.6066	2.8766	42.682	8.5299	5.7856	5.4998
Trial-27	3.2497	3.5665	8.7675	152.99	4.5899	7.5489	2.6375	7.3595	8.4169	6.0356	5.505
Trial-28	3.2086	3.7095	8.8226	149.15	4.5638	10.854	2.5584	11.136	8.413	6.425	5.4633
Trial-29	3.1856	3.5552	10.444	145.88	4.6034	5.6738	2.5936	14.327	8.3896	7.3625	5.5829
Trial-30	3.0926	3.6186	12.448	156.99	4.2644	5.7734	2.5646	3.7911	8.3429	5.9573	5.0132
Trial-31	2.6219	2.6944	3.8796	51.597	4.76	5.5261	2.1097	126.57	3.1116	4.7333	5.45
Trial-32	2.987	3.6756	10.401	153.49	4.7752	8.3424	2.5985	6.7116	8.2919	6.37	5.3741
Trial-33	3.1082	3.6216	10.822	112.27	4.8343	6.1454	2.6402	49.269	8.2283	6.2017	5.8008
Trial-34	2.6588	3.5389	10.377	163.88	3.3167	6.6335	2.6154	2.8791	7.8629	5.0545	2.9487
Trial-35	3.1711	3.5225	12.268	123.67	4.8108	6.149	2.5483	36.267	8.2516	7.1727	5.1492
Trial-36	3.1907	3.5682	16.965	156.03	4.8133	6.0889	2.4212	5.8946	8.2789	6.0214	4.7977
Trial-37	3.2384	3.5737	11.066	111.63	4.8208	6.0448	2.514	49.075	8.038	6.8449	4.9479
Trial-38	3.083	3.7175	13.392	144.57	4.8449	6.0204	2.5106	15.27	8.0196	6.864	4.9488
Trial-39	2.9821	3.6875	12.046	125.02	4.9101	5.8193	2.5342	34.111	8.1076	8.0312	4.9461
Trial-40	2.9878	3.8212	10.663	143.75	4.852	5.6546	2.5352	16.622	8.0505	6.7611	4.9843
Trial-41	3.055	3.8063	10.044	149.21	4.7838	6.6247	2.5312	11.089	8.1561	6.3341	4.9597
Trial-42	3.1205	3.6753	2.5016	38.445	2.8394	4.3863	2.0668	144.31	2.8578	3.655	3.7795
Trial-43	3.1457	3.7297	11.276	160.02	4.8265	5.5664	2.6156	0.14198	8.0871	10.865	5.0641
Trial-44	3.169	3.7367	8.5712	106.81	4.7964	8.2175	3.1293	53.379	7.8823	7.7997	4.966
Trial-45	1.8145	3.0877	10.508	166.75	2.5305	5.3793	2.6756	3.2525	7.7453	3.9536	2.8829
Trial-46	3.1606	3.6019	10.405	104.56	4.9212	5.6944	3.2616	55.673	7.8661	6.3972	4.9911
Trial-47	2.8595	3.4923	9.3302	151.93	4.932	6.7935	2.9469	8.4841	7.9378	9.2468	4.965
Trial-48	2.1978	2.7805	12.238	163.71	3.7584	5.7361	2.4129	2.3409	7.94	4.9976	3.5756
Trial-49	1.3738	2.4822	9.9038	171.9	3.8997	4.4597	1.8707	2.1201	6.2581	4.3592	1.8312
Trial-50	2.0062	3.5842	9.3732	164.21	4.0305	9.9111	2.0311	1.5003	7.9803	5.798	2.5922

Trial-51	2.825	3.5759	13.826	152.42	4.7732	5.6424	3.0168	8.6058	7.9542	5.8427	4.6446
Trial-52	2.7482	3.5932	10.99	153.26	5.1414	5.636	3.0432	6.6791	7.9537	5.2286	5.1859
Trial-53	2.2817	3.3832	9.1994	166.5	4.7379	7.3768	1.6714	0.89031	7.6766	4.2922	2.4539
Trial-54	2.6199	3.6296	10.284	158.74	2.463	6.8527	3.0015	6.4049	8.0819	5.4108	3.1968
Trial-55	2.6537	3.5272	9.8389	125.96	5.4632	5.6669	2.9743	34.166	8.1864	9.0512	5.1679
Trial-56	0.72107	3.4823	12.098	161.04	4.4434	5.7287	2.3794	1.9569	8.1925	5.5416	5.0096
Trial-57	2.6128	3.407	8.9724	130.12	5.6369	6.3665	2.9235	30.05	8.1687	5.6572	5.2404
Trial-58	2.2915	3.0109	13.662	148.37	5.8816	5.6832	2.8641	12.472	8.196	5.6234	5.1869
Trial-59	1.9363	2.3805	9.3095	162.96	3.9365	6.6893	2.0184	3.0307	8.1784	4.8156	4.1595
Trial-60	1.1974	1.9328	8.8381	111.03	4.5485	3.2283	2.8762	68.427	4.1361	6.3514	4.1347
Trial-61	0.47233	0.57752	11.582	175.04	3.8304	2.4901	2.6407	4.1866	6.1721	3.7902	2.2429
Trial-62	1.3757	1.3629	11.722	170.55	1.7364	6.3163	1.2871	2.5106	7.6382	4.3396	4.0389
Trial-63	1.1938	1.7366	13.462	167.93	2.615	6.8038	1.7427	1.7927	7.8329	4.9662	4.116
Trial-64	2.2628	3.0369	8.6024	172.1	1.0236	6.397	2.6429	3.1156	6.9283	3.1433	2.3882
Trial-65	2.1731	3.0652	15.487	165.14	0.61034	5.4534	2.9688	3.8765	7.7043	5.2083	2.5829
Trial-66	2.1054	3.2097	11.035	137.51	6.0246	6.3818	2.921	22.996	7.7109	5.8425	5.6594
Trial-67	2.1072	2.987	13.661	161.13	2.9056	5.5279	2.8642	3.1928	7.7539	5.9007	3.8761
Trial-68	1.9933	3.2362	11.342	155.8	5.8604	7.4967	2.2858	6.1037	7.9198	9.1068	4.1444
Trial-69	1.1986	2.7213	12.415	160.99	5.3807	5.5457	2.5899	2.0403	7.9347	7.4024	4.7043
Trial-70	0.93032	0.21796	14.602	167.48	0.92309	5.6057	1.0106	2.9342	7.9085	6.1271	5.3184
Trial-71	0.63958	3.0826	14.306	159.05	6.0356	5.6495	2.6986	1.9643	7.9471	6.614	5.1142
Trial-72	1.827	3.216	14.446	164.08	3.0809	5.031	2.7759	3.5341	7.9967	5.5424	1.5505
Trial-73	1.8	3.0834	9.5527	171.27	2.2968	2.8745	1.9109	8.2676	6.1864	3.5912	2.2083
Trial-74	1.7356	3.1844	10.983	174.66	3.5028	1.7048	2.7542	5.107	5.596	1.6345	0.98055
Trial-75	1.6918	3.2177	10.698	124.02	6.2713	6.4232	2.7571	36.032	8.0646	7.8537	5.4537
Trial-76	1.6479	3.2494	14.057	151.5	3.8944	5.8026	2.7535	12.472	8.0246	6.4499	4.5227
Trial-77	1.6167	3.0845	11.146	114.05	6.2975	5.8417	2.8121	45.907	8.0117	6.4059	5.3869
Trial-78	1.5878	3.0725	12.748	138.77	5.5804	5.985	2.9658	21.371	8.1216	7.3233	4.5961
Trial-79	1.0956	2.717	8.2908	175.12	4.9159	4.6039	2.9361	3.281	4.0142	3.5289	1.1855
Trial-80	0.5413	3.0946	13.242	160.88	6.3063	5.9069	3.1047	0.99017	8.0905	5.9612	4.7082
Trial-81	1.5255	3.2035	11.153	149.23	5.4978	8.2296	3.15	12.88	7.9046	5.5639	4.7629
Trial-82	1.448	3.2092	7.9102	8.8221	6.3314	5.9506	3.2298	157.22	7.9296	8.6062	6.0566
Trial-83	1.413	2.8707	1.6564	39.048	3.5805	1.5402	2.8665	147.34	3.9946	4.354	4.2759
Trial-84	1.378	2.9028	5.8965	138.06	2.8644	6.4477	2.2379	40.046	5.2439	2.9479	2.5439
Trial-85	1.3504	3.0997	4.4712	7.2116	6.048	4.5318	3.3293	168.52	3.4126	5.6653	5.3565
Trial-86	1.3478	3.1586	4.514	26.104	5.7063	3.0525	3.3159	153.3	2.0348	4.8669	3.0982
Trial-87	1.3524	3.1844	5.5317	3.3154	6.4092	3.8603	4.3765	169.75	2.6145	7.9544	4.6131
Trial-88	1.3565	3.1557	8.3997	28.84	6.4258	5.7456	3.3168	131.59	7.9626	7.4628	4.5861
Trial-89	1.3599	3.133	1.7393	6.0462	4.6565	4.4648	1.9545	175.69	4.971	6.8809	4.5444
Trial-90	1.3717	3.1078	2.3335	6.299	5.4254	1.0466	3.2635	174.6	4.7318	5.1765	4.4382
Trial-91	1.3512	2.7756	4.4782	15.057	6.1679	5.7407	2.8217	153.71	6.1842	5.5957	6.5464
Trial-92	1.3405	1.8434	1.8246	37.555	5.3559	5.3556	1.432	141.46	2.3903	5.3717	4.1723
Trial-93	1.3203	2.4249	0.46704	3.2727	6.602	5.661	2.8004	171.28	5.4801	12.848	4.5594
Trial-94	1.3035	1.9809	1.5743	53.722	4.929	5.381	1.3979	127.38	2.8108	4.4925	5.5904
Trial-95	1.329	3.0914	6.4296	168.52	2.9121	5.7725	2.1533	10.517	5.5375	3.819	1.6735
Trial-96	1.2423	3.2781	5.2869	8.6847	6.4182	4.5795	3.8107	164.11	4.8639	7.79	5.327
Trial-97	1.284	2.2112	1.1758	59.216	4.6732	6.3176	2.6189	118.34	5.6636	5.4437	4.6697
Trial-98	1.2227	3.1239	4.2372	30.077	6.1504	3.0768	3.4308	146.97	4.1025	6.5683	5.2148
Trial-99	1.2104	2.9734	1.6794	51.482	3.4476	4.3683	3.2506	134.33	3.3599	4.0219	2.8349
Trial-	2.203	2.4628	13.193	190.03	1.4902	3.7255	0.69672	3.1148	6.9162	4.6457	4.0779
Median	2.62	3.16	10.56	143.53	4.44	5.77	2.59	16.58	8.00	5.99	4.97

Link-H											
Channel	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Trial-1	8.1315	9.1695	0.5463	12.73	3.9871	91.515	26.942	8.4857	6.9336	60.243	0.9882
Trial-2	8.0458	5.0157	0.57612	11.177	2.9093	108.3	30.391	10.44	5.2424	44.507	1.1253
Trial-3	8.0216	4.7753	0.5247	10.926	2.4849	113.19	23.335	11.105	6.7952	45.78	1.1651
Trial-4	8.6275	5.1607	0.69104	10.576	1.7388	161.5	16.376	8.9331	4.4434	9.395	1.1762
Trial-5	9.1896	2.6131	0.56504	8.0102	2.5198	131.07	22.695	9.5018	5.7074	34.806	1.3816
Trial-6	8.9514	5.2716	0.5448	6.6661	1.7511	162	21.027	8.1955	3.7236	9.1753	1.1594
Trial-7	7.3989	10.244	2.0631	6.8587	1.7153	154.95	12.649	8.1639	10.461	12.717	1.4089
Trial-8	6.0938	8.4657	3.9538	6.121	3.122	145.08	10.257	7.542	16.469	19.171	2.3235
Trial-9	3.8661	7.8402	0.75466	4.4871	2.5896	84.745	7.8907	6.0641	27.676	79.88	2.8708
Trial-10	5.3084	9.5392	1.2308	3.7515	5.4857	173.36	10.267	4.5061	9.5463	2.2672	3.2987
Trial-11	5.6372	14.101	1.2672	2.8678	2.6943	132.34	8.5814	9.2768	13.94	33.02	4.8231
Trial-12	6.8793	13.794	1.1947	2.4306	3.7309	164.91	8.386	7.7703	10.591	5.4655	3.3734
Trial-13	8.3186	13.82	1.2762	1.903	2.8108	161.82	9.9128	7.2543	10.739	6.9201	3.8479
Trial-14	3.3414	15.204	2.1783	1.4582	3.9103	161.4	8.9543	4.0499	8.3472	15.822	1.5182
Trial-15	6.9285	16.34	0.87912	2.4766	3.852	158.8	12.647	6.1975	10.417	6.9552	1.5275
Trial-16	7.2634	17.927	0.8177	1.3442	4.6162	165.26	11.652	5.4428	8.3711	4.8646	0.91946
Trial-17	4.3676	10.046	0.66268	1.2246	7.2614	179.38	8.3591	4.3981	7.0303	4.8673	0.84023
Trial-18	9.3908	11	0.65906	1.3221	3.1405	139.52	11.944	7.0927	12.963	30.629	0.83499
Trial-19	6.3536	6.7073	0.9009	2.3174	4.254	159.76	8.3568	7.8811	8.071	22.43	1.5407
Trial-20	11.878	11.279	0.81235	1.1115	1.5831	164.32	9.1431	6.3071	10.742	7.594	4.7204
Trial-21	11.72	9.3726	0.4541	0.81856	6.5712	167.13	8.8178	11.595	3.1578	5.8942	2.8962
Trial-22	12.361	4.1326	0.76118	0.514	3.3888	129.7	8.4935	24.029	3.0353	39.87	2.4261
Trial-23	6.7282	6.1117	4.157	0.37605	1.7442	127.78	7.9993	17.73	4.1185	50.571	1.2601
Trial-24	13.841	5.7896	0.37964	0.51906	2.041	152.82	10.797	15.821	3.9827	21.831	0.85191
Trial-25	8.932	3.4712	1.3359	0.61049	2.6536	175.87	8.7495	11.686	3.1903	10.818	1.0369
Trial-26	10.414	6.4716	0.20386	0.72149	3.1241	176.55	9.7414	9.4017	3.8575	4.6751	1.93
Trial-27	14.235	2.4098	0.2803	2.3753	12.516	166.29	9.7674	8.9178	4.0246	5.32	2.2586
Trial-28	13.889	4.3327	0.32608	3.8085	5.3213	162.8	9.7005	8.6293	5.2994	11.576	2.6262
Trial-29	15.411	1.241	1.5195	3.914	6.5978	133.27	9.4801	15.142	5.3493	32.252	2.7702
Trial-30	14.309	3.057	0.92885	3.5577	5.9924	156.53	11.643	15.164	1.8955	10.737	3.5061
Trial-31	14.371	1.8152	0.66903	3.3201	8.0321	126.65	12.656	52.4	2.665	2.8853	2.2851
Trial-32	14.137	3.1762	1.6225	3.321	3.3256	166.37	10.16	15.334	3.4876	4.4932	1.7105
Trial-33	16.346	3.3073	1.8467	4.2616	24.487	125.96	10.318	30.276	4.1912	6.3921	1.3176
Trial-34	7.5006	4.7648	2.0527	10.518	23.484	128.11	11.748	29.764	3.9434	1.6165	4.0406
Trial-35	3.4641	4.7967	1.9533	8.6385	32.992	141.1	10.428	15.945	3.3241	1.6667	4.3113
Trial-36	3.5024	8.9538	1.7498	9.9379	31.047	133.29	10.501	20.718	3.0768	73.523	3.7421
Trial-37	3.9139	6.6719	1.6671	12.485	32.346	120.99	10.606	30.347	4.9226	1.3894	3.2393
Trial-38	4.163	3.0955	1.8186	10.917	26.59	149.69	8.9192	14.761	3.8894	2.1653	2.3987
Trial-39	5.8062	3.8446	1.9892	10.078	25.246	148.9	9.4104	15.309	4.0291	2.5019	1.5127
Trial-40	5.8984	4.7252	2.2106	13.405	26.622	115.26	9.5394	39.766	5.205	4.3316	0.74175
Trial-41	5.5745	8.8537	2.0667	7.207	24.191	140.77	9.0727	21.933	4.0017	4.4237	0.60574
Trial-42	7.1558	6.8663	2.3424	13.208	77.32	14.483	10.291	83.332	4.4893	4.911	1.5237
Trial-43	5.4018	8.8869	2.1584	4.9984	47.005	5.6531	7.7221	139.75	3.112	3.3797	0.42284
Trial-44	10.569	10.893	2.7126	13.235	90.07	12.424	7.2308	68.693	4.5115	6.6073	1.513
Trial-45	6.2639	3.122	3.4855	12.976	143.22	22.904	7.2533	16.363	4.3341	6.7887	1.5912
Trial-46	3.9423	3.7555	2.3941	13.703	72.921	46.247	8.2522	64.847	4.2905	7.2221	1.3807
Trial-47	7.7122	5.1771	4.5441	7.8226	29.117	128.39	8.543	27.456	4.2926	4.8617	0.8333
Trial-48	5.1842	2.9143	2.5192	10.599	15.951	160.74	8.1147	14.229	3.6784	1.1042	2.2621
Trial-49	6.3237	2.9635	2.0495	8.0581	10.264	162.93	10.872	17.342	4.1318	1.2916	1.0384
Trial-50	7.3591	2.4394	2.5652	9.3073	10.545	167.44	17.27	5.2619	4.2458	1.0296	0.9457

Trial-51	3.461	4.2236	1.0661	10.427	6.3458	73.597	83.492	37.375	3.529	1.974	2.1231
Trial-52	4.7469	1.8365	3.8996	6.4437	3.8525	87.59	90.856	22.056	3.1427	3.3315	0.71458
Trial-53	7.0266	2.7386	2.8202	16.536	5.9333	155.67	15.759	11.348	4.7489	1.3968	3.5323
Trial-54	6.98	1.7241	1.9575	10.369	13.205	167.23	6.83	9.3701	3.0854	1.2393	5.3418
Trial-55	7.3478	2.4325	2.5326	13.903	4.5907	123.19	8.2386	17.908	3.1925	1.3012	44.937
Trial-56	2.4394	1.2419	3.1166	10.522	7.6152	153.22	5.0141	18.031	3.4357	0.83749	21.792
Trial-57	3.1748	1.5961	4.2259	12.66	4.1835	133.57	15.992	8.7631	2.3831	3.2885	39.35
Trial-58	2.153	0.47375	3.4404	10.464	3.9309	139.58	35.208	2.9084	3.0205	6.6083	19.723
Trial-59	1.0078	1.1701	3.7013	7.0444	1.3368	112.82	76.902	3.3235	1.7111	5.9248	13.544
Trial-60	1.7048	5.2989	0.91989	7.5929	1.1504	124.82	60.745	15.433	1.7551	5.488	3.7111
Trial-61	1.948	7.7545	0.8386	9.5535	5.9805	140.59	42.107	4.5484	2.0057	4.9223	9.5036
Trial-62	2.5491	12.196	2.2668	11.431	3.3241	146.02	27.757	5.2646	8.0198	4.7252	4.9425
Trial-63	4.3196	12.392	5.3561	10.279	3.5426	134.63	35.241	5.4002	11.607	4.319	1.0528
Trial-64	5.4618	13.826	1.8522	10.977	2.4522	138.96	35.184	5.5837	10.389	2.7302	1.235
Trial-65	5.5092	10.31	3.0676	11.18	2.3317	162.4	18.682	6.6837	5.9178	1.9476	0.57089
Trial-66	5.8961	2.0582	0.84054	7.4018	9.4938	149.27	37.146	13.422	1.0205	1.0239	0.97795
Trial-67	10.678	7.4757	0.29918	11.313	4.2047	159.14	21.398	11.429	1.5042	0.48528	0.5298
Trial-68	6.4088	2.1408	0.41016	12.627	9.213	130.71	45.934	19.441	1.9673	0.32031	0.28462
Trial-69	5.0526	5.7678	0.66956	7.9546	5.3773	147.15	41.979	11.927	1.0859	0.21555	1.2968
Trial-70	10.286	5.8416	0.58904	12.18	3.9046	114.31	55.472	7.885	0.98239	15.246	2.3825
Trial-71	8.8188	8.294	1.2013	10.261	2.5777	164.81	21.733	3.3005	1.5388	3.3284	1.4525
Trial-72	8.9787	10.275	2.6959	10.072	3.6217	130.63	43.098	4.2878	2.2097	10.137	2.3446
Trial-73	6.6049	10.747	1.5114	8.7615	3.8148	171.54	10.907	3.4761	2.7678	6.8824	0.31448
Trial-74	9.2253	4.9582	1.808	8.2645	1.8853	46.971	29.831	5.4004	8.8744	110.08	0.19023
Trial-75	6.9107	6.8902	1.4447	4.8768	2.0956	125.26	23.622	2.2274	4.7249	48.977	0.33789
Trial-76	5.574	1.6014	1.5961	10.414	3.9642	86.551	26.559	6.9278	0.64455	84.46	0.34466
Trial-77	6.4991	3.1888	1.2365	9.3351	2.7985	86.418	27.071	11.978	1.0908	78.738	0.47181
Trial-78	4.54	10.911	0.85856	10.205	3.4824	85.44	19.009	13.888	1.0168	78.835	0.58413
Trial-79	5.6483	20.091	0.77061	11.507	3.5	157.91	11.448	6.2439	1.1122	8.3189	0.83008
Trial-80	2.7137	26.627	2.9382	10.616	6.1207	131.04	15.036	8.2104	1.8042	21.086	0.92927
Trial-81	2.1226	22.299	1.7071	10.058	9.6578	151.49	13.054	6.9386	1.4978	8.4318	0.97932
Trial-82	2.3403	10.054	0.73977	9.0755	2.5635	175.81	11.154	4.5822	1.3541	7.4981	1.0524
Trial-83	4.259	4.863	0.85003	10.567	4.655	116.56	25.413	10.465	1.857	47.711	1.2616
Trial-84	4.5633	7.8775	0.56722	7.3819	2.469	52.459	27.24	21.975	1.7709	101.16	1.1135
Trial-85	5.2632	10.895	0.76208	5.3405	5.6503	164.24	11.81	6.4573	1.8641	15.119	0.92331
Trial-86	7.6805	13.3	1.3586	10.336	3.6615	136.59	14.834	8.9927	2.239	28.918	0.78865
Trial-87	2.5632	3.8803	6.889	6.7522	2.7731	143.76	15.948	11.205	1.8592	32.56	0.61242
Trial-88	1.6163	3.6239	5.0646	5.0067	1.6814	99.398	24.987	6.8715	2.2809	76.071	0.59239
Trial-89	3.1832	9.1962	6.6792	6.1489	3.2835	167.08	12.063	7.4213	1.7851	10.15	0.59206
Trial-90	3.9455	3.8561	8.5562	5.3957	2.8899	110.55	17.009	12.035	2.686	59.474	0.67632
Trial-91	5.9196	5.087	8.3824	5.4783	6.2758	155.88	14.001	9.1608	47.295	16.828	0.74337
Trial-92	6.2874	2.9463	10.811	5.4082	2.6985	159.02	15.206	9.3536	1.9458	13.775	0.7668
Trial-93	4.432	7.8328	6.8487	6.0506	3.5452	148.55	13.83	7.5404	2.3984	25.57	0.68064
Trial-94	5.1594	2.915	6.5855	6.049	1.1986	84.242	29.007	10.782	63.367	79.325	0.46468
Trial-95	7.1871	4.046	4.3047	7.9757	2.8943	78.533	22.759	13.248	2.101	85.253	0.37711
Trial-96	11.461	3.5228	2.4766	8.8929	4.9394	109.88	22.88	10.395	1.9368	51.763	0.34964
Trial-97	7.9043	10.898	4.6686	5.9142	3.443	170.61	11.66	5.1062	1.2569	5.5421	0.29263
Trial-98	10.781	6.1274	4.5878	7.9962	1.8335	144.05	19.105	9.0878	2.217	22.476	0.33915
Trial-99	8.3898	4.2197	2.755	5.8278	4.055	61.638	31.929	12.199	2.0486	95.203	0.24321
Trial-	10.377	6.7494	2.2197	6.4566	6.0427	151.56	16.316	8.7064	1.2994	18.845	0.21735
Median	6.38	5.53	1.73	7.97	3.92	140.68	12.65	9.39	3.60	7.36	1.25

Cisco											
Channel	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Trial-1	1.6643	10.009	2.5581	20.133	7.116	116.36	8.4167	62.882	0.62837	5.9525	1.0415
Trial-2	1.3027	15.969	2.1893	22.657	6.784	118.58	6.4612	58.036	1.3894	2.7779	1.0686
Trial-3	1.17	14.219	2.1246	28.659	3.7381	112.39	6.7079	56.385	2.7288	8.3808	1.4722
Trial-4	0.90782	13.642	2.0349	25.574	3.8794	148.79	9.6478	27.62	2.5849	1.6608	0.89803
Trial-5	0.81656	14.224	2.15	16.575	8.2832	130.1	4.4157	52.165	2.4906	5.6798	1.3159
Trial-6	0.88694	13.583	1.8014	14.352	4.6716	50.084	3.1071	124.47	2.1978	12.414	9.3466
Trial-7	0.91456	15.845	1.6843	18.427	4.6168	116.43	7.7986	42.991	2.401	22.437	0.70932
Trial-8	0.9757	11.098	1.6411	17.679	3.5129	102.75	3.263	9.4137	0.66193	85.15	0.82819
Trial-9	1.1009	7.2179	1.4578	28.267	5.2606	146.83	6.1632	11.465	1.5685	25.285	1.8664
Trial-10	1.1316	13.353	1.2244	15.938	10.681	95.516	7.0492	15.603	15.376	75.111	1.3521
Trial-11	1.1828	8.0963	1.1357	19.738	12.911	123.05	7.6862	16.268	1.5596	46.388	1.0273
Trial-12	1.184	14.57	0.74632	15.59	5.1787	94.057	5.3195	15.411	2.0462	77.854	4.3271
Trial-13	1.1458	5.0177	0.85004	15.535	4.1276	73.01	3.3416	22.068	0.62766	103.05	0.8796
Trial-14	1.2684	3.8081	5.1575	18.77	5.2711	129.12	6.2918	17.776	0.75623	47.641	1.1916
Trial-15	1.2898	2.5613	4.5853	18.298	4.2447	53.564	1.6665	17.803	1.5143	125.82	6.222
Trial-16	1.0919	1.861	5.8425	16.907	3.5533	94.076	1.8893	6.9411	1.6409	101.08	2.5219
Trial-17	0.88001	2.2227	5.4791	15.059	6.5581	37.695	2.3979	19.777	3.3831	139.33	5.5087
Trial-18	0.83718	6.1042	5.1726	17.384	4.6249	145.58	4.6667	18.325	2.9641	28.563	1.2402
Trial-19	0.99596	2.2808	5.9819	20.125	6.1751	104	6.4837	22.333	2.4399	64.077	2.0311
Trial-20	1.003	1.7871	5.1345	17.596	4.6397	71.448	2.5932	15.371	2.1987	111.54	0.68238
Trial-21	0.29228	8.7771	4.7722	23.647	10.159	145.29	4.7336	15.913	2.4699	20.497	0.99828
Trial-22	0.43695	2.7475	5.0875	23.212	4.9754	128.75	5.9733	16.317	1.7266	45.947	1.1197
Trial-23	0.3526	2.7186	5.6397	18.244	4.924	58.212	6.4832	25.71	3.4224	109.48	1.616
Trial-24	0.56646	4.1182	5.4305	14.036	4.7912	63.491	3.2315	30.58	2.483	107.33	1.4781
Trial-25	0.46526	2.666	5.3066	16.107	4.4699	53.584	4.6861	24.275	1.6069	119.46	3.6976
Trial-26	0.89472	5.6987	5.5539	20.367	8.6828	118.05	9.2884	12.639	38.69	52.48	1.326
Trial-27	9.9396	2.7152	5.4645	20.071	4.8931	117.31	6.7634	17.116	1.2919	49.591	1.3332
Trial-28	0.77139	3.6178	5.346	27.891	5.886	97.096	6.2613	10.292	1.4452	67.753	8.1856
Trial-29	0.74371	3.0909	8.2224	18.939	4.7183	148.81	5.9633	14.263	1.6015	27.376	1.908
Trial-30	0.81186	4.9195	1.2128	25	6.353	99.915	6.6602	20.507	1.4696	67.95	0.82505
Trial-31	0.69849	7.8673	5.3704	21.302	8.623	127.99	6.0676	15.978	1.2209	38.949	0.37356
Trial-32	0.69914	4.7043	1.4457	16.013	4.2167	19.368	3.5707	17.864	0.73001	154.9	14.146
Trial-33	1.3518	4.2078	1.676	18.742	7.564	87.924	5.0547	16.825	0.6864	87.439	2.5581
Trial-34	0.50735	6.5201	3.764	26.209	4.3938	105.02	5.0292	18.202	0.58359	63.907	0.73035
Trial-35	0.44442	5.7165	2.1012	30.817	4.2595	116.49	5.214	17.554	0.53569	51.896	0.7201
Trial-36	0.43464	7.9769	3.5095	29.92	4.1248	94.302	3.7313	17.666	1.7593	71.081	3.6419
Trial-37	0.77145	11.883	5.6416	28.894	5.9205	113.61	3.7406	17.306	3.4229	41.637	0.48361
Trial-38	0.86549	8.9825	1.2562	24.728	9.5357	105.09	7.4165	17.017	3.9292	58.031	0.44616
Trial-39	0.8657	10.108	2.2733	23.303	4.0866	39.709	4.1535	29.833	1.5598	117.53	2.8995
Trial-40	0.68656	10.967	1.2678	25.321	5.4487	59.16	11.594	23.838	1.9267	92.195	1.1865
Trial-41	0.68873	7.1257	1.5792	18.338	4.5053	14.369	4.7633	10.82	7.5196	158.39	6.393
Trial-42	0.95881	9.5188	1.5356	21.941	11.651	74.516	5.293	11.093	2.8564	81.595	14.762
Trial-43	0.74392	8.4454	1.748	25.611	4.482	99.415	6.4448	10.563	1.2576	65.86	12.5
Trial-44	0.70715	13.667	1.7365	31.08	4.6391	81.195	6.3705	13.304	1.1402	66.245	18.015
Trial-45	0.69358	9.5077	2.0456	21.186	3.8673	72.139	5.9237	22.58	1.3324	92.298	5.6593
Trial-46	1.011	9.3188	1.5274	25.621	6.5132	86.417	5.2541	13.177	1.3185	74.574	13.709
Trial-47	0.718	5.417	1.7897	19.671	3.8988	41.867	3.9469	6.9872	0.83923	122.05	26.048
Trial-48	0.57058	7.0958	1.8649	26.831	4.1323	56.438	5.7354	23.733	1.4971	99.506	6.9696
Trial-49	0.44988	14.185	1.3339	28.401	7.274	76.023	7.3095	12.079	1.6084	71.69	17.488
Trial-50	0.39241	12.883	9.0005	25.429	3.7985	82.927	4.5112	11.277	1.4051	77.292	7.8914

Trial-51	0.51803	8.8425	1.4399	19.331	3.5621	29.671	3.5867	6.5985	1.2333	138.44	21.375
Trial-52	4.437	8.8035	1.3761	24.948	4.0945	83.648	9.118	13.46	2.3659	78.22	4.0268
Trial-53	0.4396	10.163	3.7325	33.88	5.5362	119.22	4.653	14.02	2.2862	36.428	5.7094
Trial-54	0.45318	8.4458	1.9309	26.743	3.3424	111.29	4.4266	18.274	2.9844	55.151	3.4873
Trial-55	0.73384	7.6352	3.1191	22.93	6.3444	83.543	9.6362	19.866	3.2195	75.172	4.3502
Trial-56	0.465	12.794	4.9738	26.72	3.3186	81.56	4.3364	17.369	3.5017	68.464	10.77
Trial-57	0.63072	8.135	1.3522	22.362	3.4789	27.46	3.5121	13.031	2.8881	130.31	22.526
Trial-58	0.85874	6.7061	1.4281	23.641	11.488	84.421	6.7748	18.59	0.73623	77.007	5.881
Trial-59	0.98869	9.9126	1.4351	23.808	5.7931	36.657	10.877	23.209	0.86575	114.11	8.1492
Trial-60	1.2901	7.4683	0.95986	29.937	3.1159	80.429	10.742	18.516	0.79901	74.414	5.0605
Trial-61	1.3074	10.47	0.66878	36.303	3.2653	97.602	5.7886	16.689	0.98062	58.281	4.6262
Trial-62	2.1523	7.317	1.4077	25.189	3.3358	37.051	14.421	17.739	3.6736	118.75	5.2354
Trial-63	1.2914	7.6744	1.3167	24.578	3.5155	25.283	5.4551	15.628	0.78516	127.34	22.746
Trial-64	1.078	8.1881	1.5384	24.831	3.4752	25.082	5.4362	23.878	0.73663	22.353	121.62
Trial-65	1.0057	6.3786	1.4503	27.894	2.9203	106.56	5.9801	16.69	0.7608	4.8949	60.226
Trial-66	1.5431	14.742	0.74332	36.542	2.6182	114.95	6.0639	14.735	0.71139	5.7369	39.992
Trial-67	0.74581	16.913	5.8483	33.866	1.6364	79.36	5.1648	14.645	0.65439	5.6864	71.236
Trial-68	0.56823	6.1542	7.1326	24.555	7.8167	112.91	5.1353	12.201	1.4278	6.4763	50.785
Trial-69	2.1039	9.0184	5.6011	24.788	5.1067	40.786	4.6751	25.215	0.92728	14.047	105.8
Trial-70	2.663	8.3798	4.6029	25.06	4.8514	40.566	6.2359	16.583	1.1051	16.607	106.24
Trial-71	0.59911	12.281	4.3117	25.242	6.1726	52.714	4.9612	13.532	1.3949	6.3019	109.03
Trial-72	0.71882	10.752	5.9573	28.262	4.498	71.504	4.5598	13.506	1.995	5.762	90.085
Trial-73	0.55333	10.441	3.8676	32.223	3.6215	82.777	6.2568	9.8513	2.2842	7.8249	77.133
Trial-74	0.65565	9.2891	4.6251	31.933	4.8301	71.384	4.769	15.567	2.2473	5.5545	87.323
Trial-75	0.98859	9.7571	4.0682	29.557	6.5494	101.29	5.9827	11.263	2.3253	5.1005	60.631
Trial-76	1.6004	8.6427	6.2318	29.008	3.3473	81.598	5.136	12.506	2.3086	40.46	45.587
Trial-77	0.86886	4.8988	3.4894	18.528	1.0871	47.916	4.8729	9.6816	1.7471	115.8	25.868
Trial-78	2.1036	10.88	4.8182	35.974	1.3252	123.36	5.3063	12.156	1.2657	36.355	4.5127
Trial-79	1.0908	9.9442	3.59	26.568	2.985	63.694	7.1568	10.197	0.75034	97.035	14.682
Trial-80	0.62934	6.1358	3.0175	21.753	2.0587	18.281	3.7656	6.4207	2.2699	88.735	84.279
Trial-81	0.32161	6.7687	3.3185	32.447	2.3366	37.095	6.6185	13.327	2.4307	14.893	108.47
Trial-82	9.4433	10.874	5.0891	36.884	2.2669	111.64	6.4878	13.266	0.55706	5.2083	35.714
Trial-83	1.2619	11.59	3.8344	30.203	2.4959	101.92	9.1475	11.497	2.1379	9.901	53.58
Trial-84	1.8358	12.849	8.0692	25.931	2.6655	58.33	5.7328	13.279	0.67793	72.016	36.416
Trial-85	0.77795	9.6021	5.6561	27.282	3.8829	64.087	4.4173	17.319	1.2264	94.21	5.9322
Trial-86	0.79029	6.9401	2.8186	27.394	2.7558	94.904	4.4216	11.378	1.7175	78.414	3.9969
Trial-87	0.88131	7.0809	6.4333	32.363	2.4442	106.37	4.8944	12.664	1.9174	56.412	5.42
Trial-88	0.77373	29.642	4.2849	17.887	2.3765	98.607	8.1474	14.131	1.6287	57.764	2.7404
Trial-89	0.57856	32.907	3.4578	12.254	2.5186	76.836	12.978	9.9368	1.1768	80.12	3.749
Trial-90	0.64353	25.459	8.8871	15.678	7.8904	77.431	15.233	11.633	1.4173	68.804	5.2323
Trial-91	0.77324	10.197	2.8863	28.26	2.654	108.33	14.241	3.683	0.96064	61.147	4.0356
Trial-92	0.64282	18.634	11.092	27.437	2.6558	94.271	9.3871	4.3122	5.6488	54.589	7.8624
Trial-93	0.75622	14.132	2.8158	27.172	2.1886	57.256	12.088	9.0831	5.8142	96.669	8.9404
Trial-94	0.47659	11.452	5.7424	30.047	3.8721	73.742	14.042	3.8497	0.8704	88.428	5.8177
Trial-95	0.34226	12.922	2.9521	23.965	3.1172	119.26	8.6446	11.527	0.51885	53.182	2.0366
Trial-96	0.3685	8.3236	8.2485	28.699	2.0603	53.283	13.703	3.3166	1.0474	99.31	18.816
Trial-97	0.29736	7.9113	5.891	28.314	5.663	87.792	11.445	5.9254	2.5586	73.73	5.1401
Trial-98	0.96084	10.06	1.8365	21.253	1.7463	31.199	2.8384	21.967	1.2257	140.72	2.4802
Trial-99	1.3822	20.205	7.229	23.825	5.1525	94.16	6.77	15.763	1.0064	56.672	3.9272
Trial-	1.401	31.453	3.7821	19.921	4.5796	122.07	6.4668	11.795	0.8108	34.298	1.686
Median	0.83	8.82	3.39	24.76	4.43	85.42	5.94	15.59	1.56	66.05	5.19

Lucent											
Channel	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Trial-1	10.46	61.30	0.16	41.27	0.22	104.50	0.70	1.27	2.54	0.05	0.12
Trial-2	0.41	20.50	0.09	50.54	0.22	155.92	0.42	0.74	2.69	1.29	0.11
Trial-3	0.45	50.57	0.30	21.27	0.22	144.62	0.44	0.95	2.66	11.16	0.11
Trial-4	0.45	40.91	20.41	60.69	0.20	105.31	1.04	0.85	2.73	0.19	0.10
Trial-5	0.44	38.64	0.22	30.48	0.20	148.44	1.32	0.14	2.16	0.42	0.12
Trial-6	0.40	30.64	30.45	62.37	0.22	83.26	1.41	0.10	3.03	0.33	0.09
Trial-7	0.31	2.35	1.74	5.22	0.23	8.12	38.90	10.50	116.88	49.17	0.08
Trial-8	0.18	30.42	30.50	46.95	10.33	98.81	1.45	0.14	2.81	11.07	0.07
Trial-9	10.23	40.56	30.52	52.49	0.26	93.65	1.09	0.15	2.96	0.76	0.06
Trial-10	30.34	0.07	10.27	58.50	0.26	87.35	31.98	0.15	3.03	0.36	29.55
Trial-11	1.59	22.36	0.97	5.30	0.24	8.27	29.07	0.16	135.85	28.83	0.06
Trial-12	0.16	0.08	44.47	111.63	0.25	40.31	11.26	0.10	2.99	0.71	0.05
Trial-13	10.17	10.25	0.23	144.98	0.21	61.14	0.98	0.11	3.77	1.05	0.05
Trial-14	20.21	0.07	10.21	144.46	10.18	0.26	1.04	0.34	14.14	0.79	0.05
Trial-15	0.19	0.06	0.88	12.91	0.21	0.96	10.92	0.11	135.24	40.97	0.04
Trial-16	30.07	30.19	20.13	114.30	20.15	0.29	0.46	0.22	4.12	12.75	0.04
Trial-17	10.20	51.17	30.16	42.81	0.21	86.86	1.04	0.87	3.64	0.73	5.30
Trial-18	0.20	0.93	0.11	4.57	0.17	20.83	19.72	19.42	145.72	17.62	3.46
Trial-19	0.81	2.29	1.38	4.61	0.19	6.55	10.14	28.98	126.49	30.61	0.04
Trial-20	29.98	40.57	0.13	44.66	0.20	89.59	0.82	1.50	3.53	1.39	0.04
Trial-21	19.96	50.26	19.98	75.27	0.19	58.61	0.75	0.23	4.78	2.66	0.04
Trial-22	1.86	40.61	0.23	70.74	0.21	111.58	0.46	1.13	4.61	1.56	0.02
Trial-23	1.34	2.40	2.19	6.56	0.19	4.77	29.30	19.59	156.64	0.05	0.03
Trial-24	10.07	10.36	0.14	40.09	8.10	157.24	0.49	1.36	4.89	0.01	0.30
Trial-25	10.11	40.33	10.19	71.86	0.19	82.54	1.25	1.03	4.77	10.42	0.05
Trial-26	0.16	40.28	10.14	92.27	0.20	81.68	1.01	2.07	3.97	0.66	0.31
Trial-27	1.39	0.33	0.12	3.39	0.19	12.36	10.10	126.95	49.58	19.35	9.65
Trial-28	11.81	60.47	0.17	10.28	20.10	122.07	0.46	4.73	2.01	0.90	0.04
Trial-29	10.00	0.14	0.18	53.77	0.23	161.20	0.82	4.92	1.68	0.06	0.01
Trial-30	20.00	0.14	20.14	10.22	69.91	64.85	0.94	3.84	0.69	0.61	0.05
Trial-31	1.35	12.05	2.14	0.91	4.16	6.15	19.60	135.94	38.68	1.41	0.01
Trial-32	0.10	10.66	0.10	2.09	30.19	173.07	1.20	4.17	1.07	0.01	0.03
Trial-33	10.11	0.15	20.11	25.87	41.03	88.16	0.49	3.55	1.85	41.35	0.05
Trial-34	20.07	0.09	0.21	10.26	51.00	144.18	0.46	4.37	0.78	1.55	0.06
Trial-35	0.10	0.03	0.87	1.63	3.61	8.82	21.07	110.63	36.47	0.03	19.16
Trial-36	11.84	0.07	0.14	11.00	28.22	174.54	0.53	4.23	0.93	1.46	0.02
Trial-37	20.08	0.07	30.26	0.31	41.15	94.00	1.37	3.36	10.99	0.09	0.04
Trial-38	0.73	24.30	0.11	0.94	6.17	4.95	19.74	127.52	48.06	0.11	0.05
Trial-39	2.02	1.54	0.13	0.95	2.25	11.80	0.62	136.77	19.68	57.63	0.07
Trial-40	0.14	20.80	0.11	20.30	23.89	161.60	1.40	3.79	0.79	0.07	0.09
Trial-41	10.08	0.20	0.08	38.20	60.07	117.18	1.06	4.11	1.85	0.07	0.10
Trial-42	1.43	21.45	0.08	1.72	2.88	9.65	10.33	48.22	136.80	0.06	0.12
Trial-43	0.80	14.50	0.88	1.13	4.25	6.20	29.53	38.60	136.64	0.06	0.13
Trial-44	20.12	10.00	20.11	0.50	71.02	63.77	11.06	1.60	3.32	0.04	0.14
Trial-45	20.21	0.02	20.23	10.46	60.42	74.79	11.03	1.28	22.82	0.95	0.16
Trial-46	0.86	0.83	0.15	1.79	10.86	4.94	0.71	19.19	117.29	76.71	0.16
Trial-47	10.21	30.53	20.23	0.52	50.45	94.76	1.28	0.38	3.06	0.56	0.35
Trial-48	10.24	0.01	20.26	10.48	21.19	123.97	1.04	0.37	1.53	2.36	0.16
Trial-49	0.21	20.71	0.19	10.51	53.01	142.61	1.29	0.37	1.77	2.15	0.16
Trial-50	0.90	3.14	2.45	1.17	1.80	10.16	19.71	19.20	85.81	88.24	0.14

Trial-51	0.21	20.71	0.20	10.52	53.35	132.96	0.92	0.48	1.38	1.75	0.14
Trial-52	0.19	21.75	0.11	1.29	1.49	3.48	10.51	0.23	99.59	83.61	0.13
Trial-53	1.60	0.06	19.38	19.65	23.03	153.21	0.61	0.20	1.49	14.00	0.13
Trial-54	0.48	1.07	0.12	0.51	1.47	5.02	0.72	0.18	10.25	212.79	0.11
Trial-55	0.77	0.06	0.53	0.77	1.78	24.94	0.66	0.21	121.05	81.86	0.11
Trial-56	0.37	0.07	0.81	1.07	1.75	3.46	0.71	10.11	10.23	204.37	0.10
Trial-57	9.73	9.69	0.24	10.08	29.27	157.90	0.71	0.22	0.82	13.99	0.09
Trial-58	0.45	0.07	0.89	0.82	1.64	4.20	0.65	0.21	21.67	202.38	0.09
Trial-59	0.44	20.88	0.15	0.77	1.31	15.87	20.42	10.08	69.57	93.15	0.08
Trial-60	0.17	0.91	0.08	1.04	0.68	16.58	40.32	10.06	69.55	93.20	0.10
Trial-61	1.65	40.19	0.14	19.85	32.96	105.00	1.71	0.66	4.96	5.38	0.09
Trial-62	0.94	0.08	1.02	0.86	3.09	3.65	0.68	9.97	19.78	193.04	0.08
Trial-63	0.20	12.22	0.52	1.23	1.91	4.75	30.16	19.79	59.20	92.34	0.07
Trial-64	0.17	60.45	0.14	10.17	37.19	112.63	1.62	1.62	3.68	5.50	0.07
Trial-65	0.16	50.11	7.87	39.29	34.66	78.43	1.59	0.68	3.70	6.40	0.05
Trial-66	0.51	0.10	0.18	1.22	1.59	8.48	0.57	9.97	0.24	210.26	0.04
Trial-67	0.13	21.56	0.14	0.82	2.72	5.82	30.11	13.63	69.11	88.63	0.03
Trial-68	0.13	9.77	9.96	19.89	31.11	149.99	2.21	1.13	4.10	4.95	0.04
Trial-69	0.15	97.42	0.20	0.23	40.66	79.59	0.66	0.32	0.12	13.91	0.02
Trial-70	0.15	10.66	0.13	0.25	1.53	17.94	30.20	0.78	79.04	92.04	0.02
Trial-71	0.16	1.22	0.52	0.69	0.78	27.14	40.04	0.13	29.91	112.38	19.74
Trial-72	0.20	60.33	0.13	0.27	48.91	100.57	0.58	0.23	5.39	5.25	1.06
Trial-73	0.18	19.70	0.06	0.28	46.73	141.84	0.54	0.27	9.50	2.76	1.15
Trial-74	0.16	11.75	0.25	0.14	1.98	6.91	30.00	0.24	150.07	21.36	9.89
Trial-75	0.22	12.74	0.67	0.10	2.00	5.14	20.18	10.05	171.16	0.10	0.06
Trial-76	0.19	39.22	0.26	0.17	19.88	160.56	2.47	0.68	7.34	2.44	0.02
Trial-77	0.19	19.91	0.23	0.15	67.08	132.70	0.56	0.08	8.75	3.54	0.02
Trial-78	0.57	0.08	1.19	0.59	2.26	26.21	79.32	0.10	19.96	102.43	0.02
Trial-79	0.20	1.77	0.47	0.59	1.83	6.52	10.45	0.12	0.14	207.38	3.71
Trial-80	0.19	19.68	0.44	0.17	62.56	127.05	5.78	0.14	1.12	5.76	0.04
Trial-81	19.65	69.72	0.26	0.21	48.92	71.77	3.69	1.09	2.09	5.49	0.05
Trial-82	0.18	0.19	0.36	0.20	3.77	7.28	20.26	0.11	9.98	190.80	0.05
Trial-83	0.20	0.96	0.78	0.22	1.78	7.99	0.67	0.14	10.08	210.32	0.05
Trial-84	0.18	19.99	0.24	0.17	11.98	178.01	5.49	0.14	0.80	5.86	0.05
Trial-85	0.25	2.07	0.24	0.19	2.79	4.45	108.97	0.16	10.17	82.75	0.06
Trial-86	0.25	0.59	1.99	0.19	2.77	3.81	0.63	0.14	0.34	222.33	0.08
Trial-87	0.23	12.81	0.71	0.55	3.18	3.51	77.45	9.95	29.85	94.43	0.07
Trial-88	0.21	19.90	0.27	0.19	19.64	170.52	6.13	1.30	0.14	4.54	0.07
Trial-89	0.20	53.23	0.31	0.15	46.73	99.33	5.68	1.25	0.16	5.45	0.08
Trial-90	0.20	4.21	0.68	0.22	3.23	3.28	39.99	0.23	0.17	180.88	0.08
Trial-91	0.18	10.48	1.27	0.23	3.62	15.35	108.87	0.22	9.97	82.44	0.09
Trial-92	1.65	59.73	19.99	0.21	49.24	89.12	4.93	0.67	1.62	5.99	0.09
Trial-93	0.50	13.19	0.87	0.20	2.39	3.46	126.79	10.09	9.98	65.13	0.09
Trial-94	0.60	0.09	1.14	0.29	1.61	7.31	28.80	0.27	0.15	192.79	0.09
Trial-95	0.55	11.82	1.52	0.22	1.98	4.42	99.34	10.77	10.00	91.97	0.09
Trial-96	9.86	40.96	29.54	0.21	66.42	73.03	5.43	0.27	1.20	6.26	0.09
Trial-97	0.60	2.06	1.24	0.09	1.60	4.01	89.54	10.02	20.54	82.26	0.07
Trial-98	0.88	1.78	1.14	0.13	0.85	4.81	20.49	0.13	0.23	202.61	0.05
Trial-99	0.22	2.42	0.86	0.09	2.17	3.45	89.72	0.13	29.88	83.11	0.04
Trial-	29.85	10.63	0.47	0.26	56.08	122.21	5.85	0.11	0.20	7.65	0.04
Median	0.51	10.66	0.53	1.26	2.78	62.45	1.66	0.86	4.69	5.92	0.08

APPENDIX G: MEDIAN OF MEDIAN DWELL TIME

This appendix includes the tables showing the median of the median dwell time for all the 100 trials and for each of the 11 channels.

Median of Median Dwell Time

Channels	1	2	3	4	5	6	7	8	9	10	11
Airlink	0.00335	0.00111	0.00095	0.01131	0.01528	0.00105	0.00314	0.00152	0.00157	0.00251	0.00316
D-Link	0.01139	0.02292	0.04707	0.39028	0.03183	0.03147	0.01348	0.62015	0.04805	0.03318	0.03192
Intel	0.00159	0.00205	0.00288	0.00125	0.01036	0.00633	0.00117	0.00204	0.00204	0.00077	0.00548
Link-P	0.01558	0.01841	0.04900	0.87330	0.02751	0.03274	0.01606	0.07793	0.04714	0.03294	0.02969
Link-H	0.00236	0.00163	0.00087	0.00637	0.00096	0.00644	0.00558	0.00263	0.00175	0.00559	0.00124
Cisco	0.00110	0.00103	0.00177	0.02168	0.00335	0.00191	0.00144	0.00183	0.00080	0.02435	0.00216
Lucent	0.00099	0.00101	0.00076	0.00145	0.00204	0.00159	0.00288	0.00073	0.00306	0.00217	0.00099