Performance Analysis of Interface Bonding and Channel Bonding at Point to Point

G. F. Shidik and Z. A. B. M. Noh

Abstract—In this research, we have done the experiment by applying interface bonding and channel bonding techniques using Point to Point topology on wireless 802.11n to achieve greater performance of network transmission compare with normal wireless link. Some of parameters are used to measure the performance of the proposed methods, such as delay, jitter, data loss rate and throughput that applied on TCP/UDP protocols. Some of experiment setup such as Different Packet Sizes and Directional Traffic Flows also conducted to measure the capability of proposed methods. The results showed that Channel Bonding has significant throughput improvement when applied at Point to Point connection used wireless 802.11n by optimizing the available bandwidth. Different result is obtained with Interface Bonding where the performance transmission is lower than normal link.

Keywords—Channel Bonding, Interface Bonding, Point to Point, Wireless 802.11n.

I. INTRODUCTION

POINT to Point (PtP) wireless can be configured as wireless bridge that allows geographically distant sites to be interconnected. Nowadays with the ever growing demand for high throughput bandwidth, Point to Point wireless connection should be able to serve more bandwidth for many kind applications such as real-time multimedia services [1]. These requirements lead some techniques was developed to achieve more bandwidth.

The improvement of IEEE 802.11n compare with IEEE 802.11a/b/g brings optimization to theoretical throughput 135 Mbps in single channel spectrum 20 MHz [2]. IEEE 802.11n also provides opportunities to achieve higher bandwidth through channel bonding mechanism. In channel bonding, two 20 MHz channels are combined into a single 40 MHz channel that caused the transmissions band enlarge, increased the packet transmissions and reduce the transmission time [3].

Linux Bonding or Interface Bonding is the technique that could aggregate multilink interfaces become as a single logical links to reach higher quality and capacity that used to increase the network performance [4]. Interface bonding is also known as link aggregation, port trunking or stripping [5]. The implement Interface Bonding or Linux Bonding at wired has been standardization as IEEE 802.3 ad link aggregation [6]. Interface Bonding or Linux bonding is contained in Linux kernel, where the kernel libraries and classes with detail explanation could be seen at [5], [7].

The motivation of this study is to analyze the performance of Interface Bonding and Channel Bonding on Point to Point wireless 802.11n to give the significant information of implementation of those techniques.

II. RELATED WORK

Channel bonding is a feature that implement on 802.11n as proposed by TGn Sync [2], [8]. Operate Channel Bonding in IEEE 802.11n needs to implement on High Throughput (HT) Green-field mode [9]. It used to activate the stations that capable to run on Channel Bonding. Based on [10], the performance of Channel Bonding on IEEE 802.11n would reduce significantly when get interference from single active IEEE 802.11g link, and their work also show that wide band of Channel Bonding can potentially larger the number of interferers. In [3], they made comparative analysis research of performance Channel Bonding with Multi Channel CSMA and [11] made comparative analysis with Single-channel 802.11.

At Interface Bonding, there has been some previous research on aggregating multiple wireless links that have looks for aggregate multiple IP link. In [12], the research focus to present an adaptive approach to inverse multiplexing reliable transport protocols in wide-area wireless access network (WWAN) environments. While in [13] provide the research to aggregate the bandwidth of multiple IP links by splitting a data flow across multiple network interfaces at the IP level. It is applicable to connectionless (UDP) flows as well as for stripping the data flow in a TCP connection across multiple IP links. Meanwhile, [14] has able to aggregate three wireless links, into one logical link that only achieve maximal improvement throughput on UDP, but instability occur on TCP side. In [15], the research is able to utilize all available bandwidth on wireless 802.11g that applied in unstable wireless environment.

Based on those researches, there has been no studies that measure the performance of Interface Bonding and Channel Bonding on point to point wireless 802.11n.

III. TESTBED EXPERIMENT

The research study was conducted at Lab environment that might be still has interference with other wireless devices, since we cannot control the interference. The signal strength of wireless devices is set in strong signal condition during experiment.

Based on [16], we used D-ITG to generate and measure the traffic at end to end nodes such as Delay, Jitter, and Data Loss Rate with Round Trip Time RTT mechanism. Winbox [17] is also used to measures Throughput in router devices where the traffic is generated at end nodes using D-ITG that applied One Way Delay OWD mechanism. Mikrotik ROS v5.2 [18] used to make standard PC works as router that would able to provide Interface Bonding and Channel Bonding at Point to Point links used wireless 802.11n. Different packet sizes and
directional traffic flows are also used on this experiment to provide comprehensive data with constant payload size. Last, comparison is used to analyze the solution. If there is significant difference in the result between before and after optimization, it can be implied that optimization technique has achieved near/ optimum solution.

IV. DISCUSSION

The optimal throughput of Interface Bonding and Channel Bonding are achieved in UDP protocol that showed better performance than TCP protocol since it does not need retransmission for packet that has been lost. The used of acknowledgement [19] and maximum transmission unit (MTU) [20] will also reduce the throughput performance in TCP.

The throughput achievement at bidirectional traffic flows will decrease significantly at all sample packet sizes that has been generate since wireless is half duplex [21], [22], [23].

Channel bonding are able to maximizing available bandwidth resources of wireless 802.11n on Point-to-Point connection by combine the bandwidth spectrum from the standard 20 MHz become 40 MHz. Since the bandwidth, transmission is enlarged it make packet transmission rate increase and reduce the transmission time [3].

The results of Interface Bonding at this experiment are different with [14] and [15] where the performance result is less than normal wireless link. We analysis the reasons are Media Independent Interface (MII) and Round Robin scheduling algorithm in Router unable to work properly on wireless 802.11n. Refer to [6] algorithm Round Robin will split packet that transmit in sequential order from the first available slave through the last. It means the number of packet that split, will be sent with same amount sequentially to all interfaces. Based on [24] Round Robin only suitable for homogeneous and stable links such as wired. Since the wireless link is unstable the possibility of link failure is more often, Round Robin scheduler will always send the packet data sequentially with same amount without cares with actual data rates each links or even the link is failure that will caused higher data loss.

V. CONCLUSION

The optimal throughput of Normal wireless link, Interface Bonding and Channel Bonding that achieved in UDP protocol showed better performance than TCP protocol. By maximizing available channel band resources to wider bandwidth, Channel Bonding has significant throughput improvement when applied on Point-to-Point connection used wireless 802.11n. Different result is obtained with Interface Bonding where the performance transmission is lower than normal link. Analysis result showed that Media Independent Interface (MII) and Round Robin scheduling algorithm unable to work properly on Point to Point connection that used wireless 802.11n.

REFERENCES

**Guruh Fajar Shidik** has received Bachelor of Information Technology from Dian Nuswantoro University, Semarang, Indonesia UDINUS in 2009, M.CS (Master of Computer Science) from Technical Malaysia Melaka University (UTeM) in 2011 and currently he is a PhD student in UTeM and a lecturer in UDINUS. His area of interest is in Internetworking Technology, Wireless Communication, Computer Vision & Machine Learning.

**Zul Azri Bin Muhamad Noh** has received Bachelor, Master of Science (MSc) and PhD in Comp Engineering at Nagoya Institute of Technology, Japan. Currently, he is a lecturer in Technical Malaysia Melaka University (UTeM). His area of interest is in Internetworking Technology, QoS, and Wireless Communication.