Robust Header Compression with Load Balance and Dynamic Bandwidth Aggregation Capabilities in WLAN

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Abstract

The vigorous development of WLAN in recent years has introduced various kinds of WLAN techniques and research subjects been brought up. The development of WLAN in recent years has deeply involved in our life. Besides of applying in home and office, IEEE 802.11 is also used in medium to long distance wireless transmission. Therefore we proposed a “Traffic Splitter Gateway Mechanism” that utilizes the link aggregation method in combination with RoHC to flexibly switch channels and utilize the wireless resources more efficiently in WLAN.[1]

Keywords: IEEE 802.11, link aggregation, Traffic Splitter Gateway, WLAN, RoHC.

1 Introduction

The vigorous development of network in recent years, surfing the internet, becomes a daily routine for everyone. The deployment of fixed-line network is often limited with transmission distance of 100m by the Ethernet 100BASE-T and the tracking between close buildings via road. One way to solve it is to rent a dedicated line from ISP, but it will cost an unreasonable huge expense. Besides, it is not reasonable to link a computer in the neighbor LAN network through WAN. Moreover, some people proposed the infrared ray transmission, but the biggest problem of it is the low transmission speed and is easily influenced by environment. Laser transmission mode contains certain risk and will be influenced by the climate conditions, in addition, the price and election isn’t available to most people.

Due to the development of WLAN, various kinds of techniques and research subject are unceasingly raised so the problem has a new solution. So far IEEE 802.11g is a very popular transmission protocol, and its transmission rate reaches as high as 54Mbps. Therefore we propose an improvement for the trunking mechanism of IEEE 802.3ad and apply it to Wireless Trunking [1]. We want to set up a wireless trunk and increase bandwidth without changing existing equipment, merge and promote bandwidth of wireless backbone, monitor WLAN transmission condition, and use load balance to allotment of transmission.

In this paper, we will discuss how to build a wireless trunking under the frequency spectrum of unlicensed band designated for wireless network. We use IEEE802.11g to build our wireless environment. By using this standard, we can have 11 available channels. To avoid channel interference, we use as many channel as possible, channel 1, channel 3, channel 5, channel 7, channel 9 and channel 11, by doing so, we can have 192Mbps of bandwidth available. The proposed Traffic Splitter Gateway mechanism can classify the incoming information into 3 types (realtime, non-realtime and general) and then put them in 3 queues. Also, we take the advantage of IEEE 802.3ad to dynamically adjust usage of bandwidth. The proposed mechanism combines IEEE 802.3ad with Robust Header Compression (RoHC) that provides header compression, to efficiently increase the performance of wireless network transmission [2,3,6,7].

The rest of this paper is organized as follows. Section 2 introduces the related works. Section 3 presents Design and implementation. Section 4 introduces the performance evaluation. Conclusions are shown in Section 5.

2 Related Works

In this section we will talk about link aggregation services and Robust Header Compression (RoHC) by explaining relative basic principles, frameworks and applications.

2.1 Link Aggregation Services

The basic concept of IEEE 802.3ad is based on the

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network layer-2 protocol. We turn off the spanning loop function of switch equipments and merge two or more bandwidth together. With the help of trunk link we can set up a virtual logic connection between two DTE that are composed with N full-duplex paths which are in parallel.

Advantage

- Increase Bandwidth
  It can merge many paths into a logic path to raise bandwidth. Theoretically bandwidth will be increased linearly.
- Increase Reliability
  If any entity line is broken down in logic path, it will not affect the connection. The trunk link has the backup function.
- Load Balance
  It can scatter the MAC-client traffic load to each path by using trunk link. When trunk link is settled logically, there is only one line. However as long as one entity line is broken down, the trunk link load balance will shift traffic to the other path. At most four entity lines can be used to form a logic connection at one time.

Disadvantage

- Does not support multi-node
  Basically it only supports connection between two nodes instead of multi-nodes. Figure 1 shows that if multi-node is supported, it will cause the loop problem.
- Does not support different MACs
  The IEEE802.3ad only supports 802.3 series of MAC protocol instead of other network environments.
- Half-duplex model
  The trunking system only supports half-duplex model.
- Does not support links of different speed
  The trunk link doses not support links of different speed. It is not allowed for each DTE to use different speed such as 100Mbps to 10Mbps. Links with the same speed is essential.

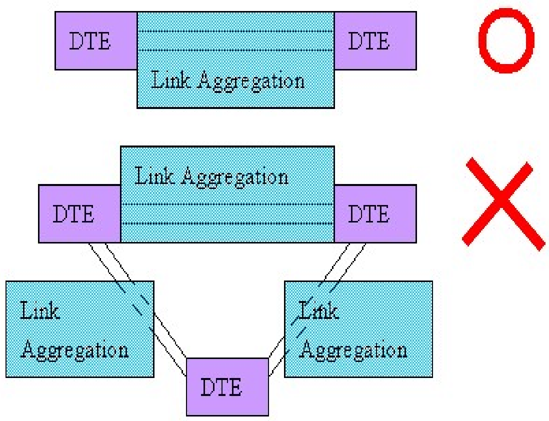

Figure 1 Multi-node connection will have the loop problem

Figure 2 shows the cadre of trunk link. What we propose in this article is based on this cadre and we do not have to correct any cadre and rules. We will set up a Link Aggregation Sub-layer (LAS) as the middle process function with the MAC-client above it and MAC below it. The procedure still follows the original one because LAS functions are used as the communicator. So we focus on the key LAS and make some modifications in order to support wireless trunking and improve transmission efficiency.

IEEE 802.3ad has a set of Beowulf system which the core bonding is based on this opening program. The basic cadre is made from a little correction of the bonding part of Linux core. It also develops a way for managers to conduct management easily, and we use it as a basic frame to design and improve the wireless trunk system. Figure 3 shows that those three network interfaces will be bonded into a large network interface. The MAC of this bonded interface is the one of the first interface. It should be noticed that the program in the core part of Linux is modified under IP layer. The advantage to do so is that we do not have to pay extra attention to the network support when the network interface card is changed. Basically all network interface card should be able to work for this program.

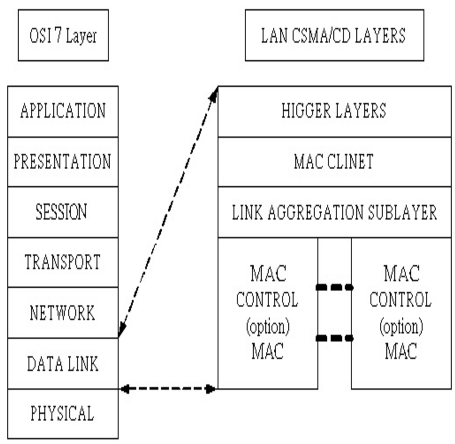

Figure 2 Trunk link framework

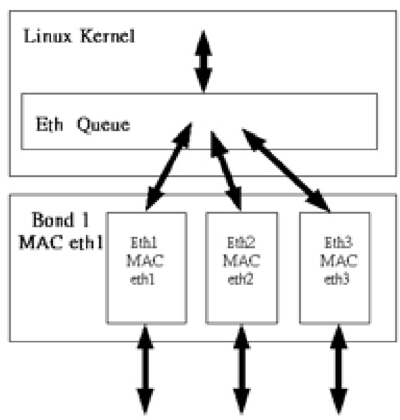

Figure 3 Bonding system Architecture

2.2 Robust Header Compression (RoHC)

In the modern world, the mobile devices are increasing in astonishing both in speed and quantities. Vast users are demanding for more services and most of them are multimedia services. RoHC is a versatile header compression scheme developed by the IETF's RoHC working group and is defined in RFC 3095[4,5]. RoHC provides improved performance over IPHC, and CRTP in high BER and high RTT wireless links, by reducing the impact of context de-synchronization. The RoHC is to keep away from sending redundancies information in header field, this redundancy can be static or dynamic. The static header field can be as Version, Source Address, Destination Address and Flow Label.

As for the operation, it consists of 3 kinds of modes, Uni-directional mode (U-mode), Bi-directional Optimistic mode (O-mode), and Bi-directional Reliable mode (R-mode), as shown in figure 4.

- Unidirectional mode (U-mode)
  There will be no feedback during the entire session, the compressor finite state machines (FSMs) will start by sending few packets will full header, and will pretend the de-compressor's FSMs has received the complete header information and is ready to decompress the compressed packet, it will move to SO state by sending only CID, pretending the de-compressor's FSM can decompress the compressed packet without problem, since it will be no feedback used, it uses 2 timers that periodically move the compressor's FSMs downward to lower compression state.
- Bidirectional optimistic mode (O-mode)
  In this mode, the feedback is used, only when an unsuccessful decompression occurred.
- Bidirectional Reliable mode (R-mode)
  The feedback channel is used much more frequent, this is used to gain robustness but with the cost of compression rate.

As shown in figure 5, compressor's FSM comprises the Initiation and Refresh (IR) state, First Order (FO) state and Second Order (SO) state. The IR state consists of sending complete and uncompressed header information to the de-compressor. The FO state consists of sending partially compressed header, basically the static field is compressed and dynamic field isn't. The SO state consist of compresses header, it sends only Context ID (CID) alone with payload, and the de-compressor can extract the compresses information without problem.

As for de-compressor's FSM, it comprises of the No Context (NC) state, Static Context (SC) state and Full Context (FC) state. The NC state expresses that the de-compressor's FSM doesn't have any header information, and haven't decompresses successfully any compressed

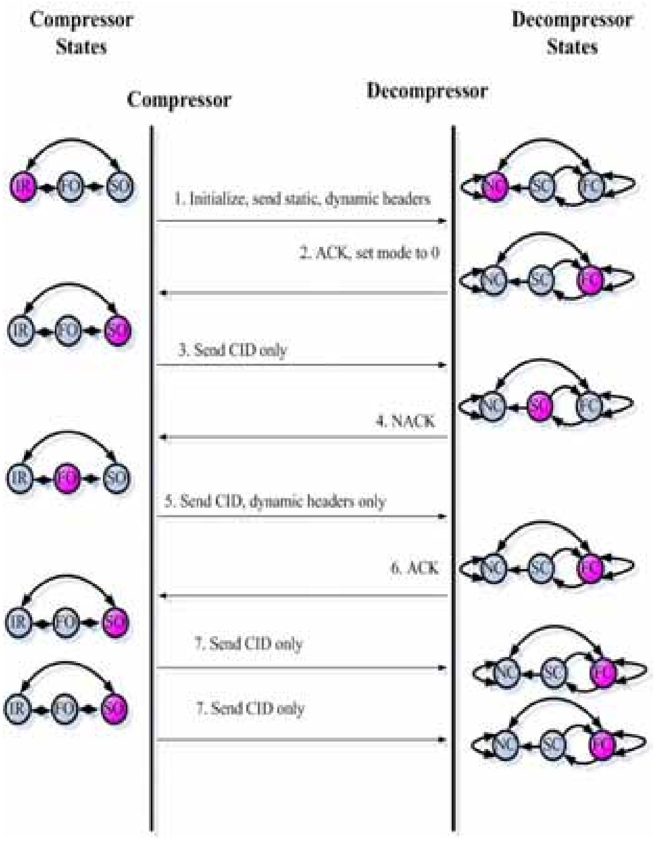

Figure 4 Finite state machines of RoHC Trunk

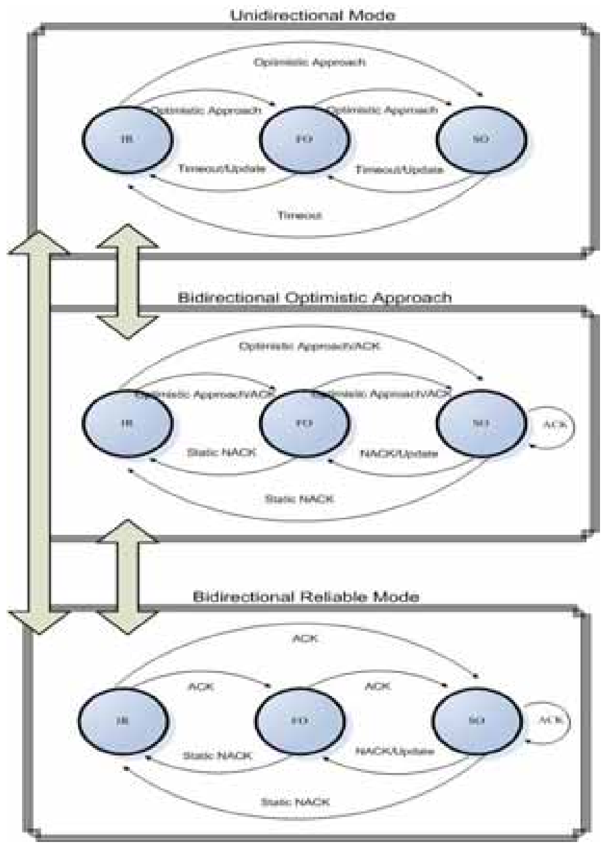

Figure 5 Finite state machines for the ROHC compressor/decompressor