Virtual AP for 802.11 Seamless Handoff
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Abstract

This memo documents the concept of virtual AP which refers to using multi physical APs to simulate only one virtual AP, method and process used for seamless handoff between APs upon IEEE802.11 network. It defines the stages to actualize smooth handoff, mentions the concepts, theories and requirements in these stages.

Conventions used in this document

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC-2119 [i].

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1. Introduction

The handoff duration could affect the quality of packet transition in the wireless channel between AP and station. When a user is using wireless terminal to receive voice stream by connecting with AP through wireless channel and moving from one AP's coverage region to another, handoff may take place in the overlay region. We must seek an effect method to narrow down the duration existing in the handoff process to maintain the high quality of corresponding.

As most of the duration is existing in the detection and search stages, we use virtual AP to reduce the most part in these stages. IEEE802.11f protocol also works in this method for solving the main problems of exclusive channel collision and corresponding between APs.

2. Terminology

access point (AP)
Any entity that has station functionality and provides access to the distribution services, via the wireless medium (WM) for associated stations [1].

association
The service used to establish access point/station (AP/STA) mapping and enable STA invocation of the distribution system services (DSSs).

disassociation
The service that removes an existing association.

distribution system (DS)
A system used to interconnect a set of basic service sets (BSSs) and integrated local area networks (LANs) to create an extended service set (ESS).

handoff
The handoff refers to the process of the association exchanged by a mobile station from one AP to another.

handoff duration
The handoff duration, which is often referred to as the handover latency or handover delay, is the period when the STA is unable to exchange data traffic via its old and new AP.

mobile station
A type of station that uses network communications while in motion.

station (STA)
Any device that contains an IEEE 802.11 conformant medium access control (MAC) and physical layer (PHY) interface to the wireless medium (WM).

virtual Access Point (virtual AP)
A virtual AP is a logical entity that to a STA is indistinguishable from a physical AP residing within the same enclosure.

wireless medium (WM)
The medium used to implement the transfer of protocol data units (PDUs) between peer physical layer (PHY) entities of a wireless local area network (LAN).

3. The realization of virtual AP

3.1 The concept of virtual AP

A virtual AP is a logical entity that to a STA is indistinguishable from a physical AP residing within the same enclosure [2]. As with all idealizations, a virtual AP implementation may approximate the ideal behavior to a greater or lesser degree.

Although there may be many different physical APs in one distributed system, STAs which are under the coverage area will consider itself only associates with one AP. So, when a STA is moving from the coverage area of one AP to another, it will not detect the loss of the association.

In order to provide STAs with the illusion of only one physical AP within the same enclosure, it is necessary for virtual APs to emulate the same operation at the MAC layer.
Virtual APs emulate the MAC layer behavior of physical APs by operating with the same BSSIDs, SSIDs, channel, mac address, capability advertisements and default key sets.

3.2 The issues of virtual AP

1) multiple association
   In the 802.11 standard [1], the station MUST have only one single association at a given time. But when the sta move into the overlap region, it may connect to not only one AP at the same time because all the MAC layer parameters of APs are the same.

   In order to solve this problem, we use the 802.11f [3] standard to provide the enforcement of the restriction of ISO/IEC 802-11:1999[1] that a STA may have only a single association at any given time.

2) channel collision
   As the working channels of all APs are set identically, the channel collision probabilities are becoming larger than before. To make it worse, serious collision can make the packet transition rate much lower, or even obstruct this transition. The capability of the DS using virtual AP will obviously becomes smaller than the normal situation. But we think it is acceptable for users.

3) security problem

4. The procedure of 802.11 seamless handoff

4.1 Association phase

   When a STA is trying to associates with one AP using an 802.11 association request frame in the coverage area, AP which receives the association request will send an IAPP-notify packet to inform other APs in the same DS. There may be more than one AP receiving the association request of the STA, which often happens when the STA is in the overlap region. To solve this problem, we add a timestamp in IAPP-notify frame. By comparing the timestamp of each IAPP-notify frame sent by the APs, we can conclude which AP to associate with the STA. Once the association is established, a Layer 2 Update Frame will be sent to cause the forwarding tables of layer 2 internetworking devices, e.g. bridges and switches, to be updated.

4.2 Handoff detection phase

   The actions during the detection phase vary depending on which entity initiated the handover. However, the most common handover is the one initiated by the station, in which stations have to detect the lack of radio connectivity based on failed frame transmissions. Most STAs will explicitly probe the link by sending probe requests after a
series of unsuccessful transmissions [4]. Different cards showed
different detection times depending on the number of failed frames
allowed and the number of probes sent. Commonly, this will cause
obvious handoff delay. In Virtual AP circumstance, the handoff is
network initiated. The AP determines when the handoff takes place by
detecting the radio signal strength. This will avoid the handoff
delay due to the handoff initiated by the station.

4.3
Handoff execution phase

Once other AP received data frames from the move station that this
station has move into the AP coverage area, it will attempt to send
an IAPP MOVE-notify packet to the AP with which the move STA
was previously associated to notify that AP of the STAÂ’s association.

5.
Formal Syntax

The following syntax specification uses the augmented Backus-Naur
Form (BNF) as described in RFC-2234 [ii].

6.
Security Considerations

The current version of this document does not change the underlying
security issues inherent in the existing 802.11 standard. In the
future versions, new security requirements may be added.

7.
References

7.1 Normative reference

i  Bradner, S., "Key words for use in RFCs to Indicate Requirement
Levels", BCP 14, RFC 2119, March 1997

ii  Crocker, D. and Overell, P.(Editors), "Augmented BNF for Syntax
Specifications: ABNF", RFC 2234, Internet Mail Consortium and
Demon Internet Ltd., November 1997

7.2 Informative reference

IEEE Standard for Information TechnologyÂTelecommunications and
Information Exchange between SystemsÂLocal and Metropolitan Area
NetworkÂSpecific RequirementsÂPart 11: Wireless LAN Medium Access
Control (MAC) and Physical Layer (PHY) Specifications.

[2] Bernard Aboba, ÂVirtual Access PointsÂ, 11-03-154r1-I-Virtual-
Access-Points.doc, May 22, 2003


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