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Juggler Radio Network Using Virtual Wi-Fi

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Abstract: ***A mobile ad hoc network is a kind of wireless communication network that does not rely on a fixed infrastructure and is lack of any centralized control. Any single radio interface that is dynamically switched to a wireless channel in different frequency bands to communicate with different nodes. This however incurs frequent channel switching overhead of the order of 100s of microseconds which is comparable to packet transmission times. A more practical method for concurrent channel usage is to use multiple radio interfaces .A multi-channel wireless mesh network architecture (called Hyacinth) that equips each mesh network node with multiple 802.11 NICs. We address the problem of interference aware routing in multi-radio infrastructure mesh networks where in each mesh node is equipped with multiple radio interfaces and a subset of nodes serve as Internet gateways. In proposed Virtual Refined Wi-Fi Additional interfaces can support parallelism in network flows, improve handoff times, and provide sideband communication with nearby peers. Completely, such benefits are outweighed by the added costs of an additional physical interface. Instead, virtual interfaces have been proposed as the solution, multiplexing a single physical interface across more than one communication endpoint***

Keywords: Ad-hoc, Virtual Wi-Fi, Radio interface, Multiracial, WMN.

I. INTRODUCTION

A. Ad Hoc Networking – An Overview With the rapid development of mobile technologies however, the use of networks is not limited through earthbound cables anymore. The potentials of such wireless networks are not fully explored yet. Mobile telephony is the most basic application making use of them, but the list only starts there. Mobile and Wireless technology is growing at a rapid rate. Combining peer-to-peer techniques with the opportunities that mobility offers, so called ad hoc networks have become an important field of research in recent years. Ad hoc networks are a consequence of the research efforts in Mobile and Wireless Networks. It is a class of wireless networks where there is no fixed infrastructure. Unlike traditional wireless, networks, they do not have base stations to Coordinate the activities of mobile host, Each node acts a router transmitting messages from one node to another. These nodes also need to perform All other functions involved in any network. The hosts are also mobile; therefore the network topology changes frequently. Dynamically changing topology and lack of centralized control makes it very challenging to incorporate various network layers into ad hoc networks. An ad-hoc network is a wireless communication network composed of mobile nodes with neither the base infrastructure network nor the base stations.

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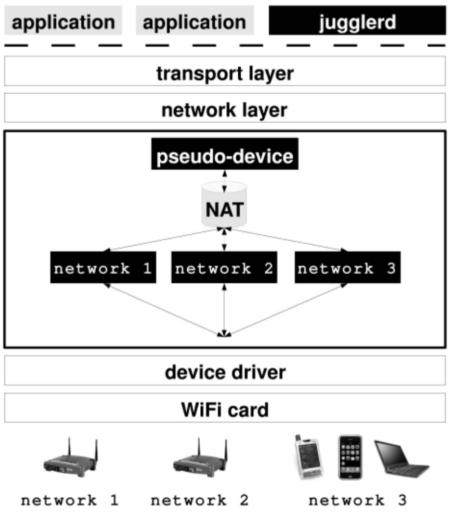

A. Ad Hoc Characteristics

A Mobile Ad Hoc Network (MANET) is a collection of mobile nodes that are dynamically and arbitrarily located in such a manner that the interconnection between nodes is capable of changing on a continual basis [9].

It is an infrastructure less network. There is no pre-image that can be made on how the network will be formed. Even after the formation of the network, the topology is still unpredictable.

Nodes in the network communicate with each other through radio signals, which are broadcasted to the whole network and can be received by everyone. The increasing recognition that wireless clients can often benefit from additional radio interfaces. For example, multiple interfaces can increase effective bandwidth through provider diversity [6], alleviate spot losses with spectrum diversity [7], and improve mobility management through fast handoff [2,9]. Despite such compelling advantages, devices with multiple interfaces remain the exception rather than the rule Virtual Wi-Fi seeks to provide these benefits with a single radio [2]. It virtualizes a single wireless interface, multiplexing [7] it across a number of different endpoints. While promising, this work remains incomplete. Switching times, even with chipsets supporting software MAC layers, are at least 25 ms. This may still be too high for many potential multi interface applications. Virtual Wi-Fi also made no modifications to wireless device drivers, and consequently, incurred unavoidable overhead as a result of delays and device resets inherent in the third-party driver code. Furthermore, Virtual Wi-Fi's API can be cumbersome, exposing the multiplexed interfaces at the application layer.

This forces the application to explicitly manage networks that come and go, complicating applications whether they can benefit from this functionality or not. Network topology continues changing. Nodes are free to join and leave the network whenever they want.

They are able to move around while still maintaining their connections. In a word, the network is highly dynamic. The mobile nodes in MANET are usually resource constrained. The joint nodes are usually laptops, PDAs and even network-enabled mobile phones. These mobile devices usually have low computational power and limited battery life. Essentials and vulnerabilities of Ad Hoc Networks another specialty of ad hoc networks is their heavy reliance on inter-node communication. Due to the dynamic nature of the link between the single nodes, it may happen that a certain node B is not in range of node A. In these cases, the information can be routed through intermittent nodes. The possibility that a certain data route becomes unavailable is significantly higher than in fixed-location networks. This makes it easier for attackers to disrupt the network than in conventional networks. Juggler, a refinement of Virtual Wi-Fi's virtual network scheme. Juggler is a virtual networking stack implemented at the link layer, with support from the device driver. It provides switching times of approximately 3 ms, and less than 400 s when switching between endpoints on the same channel. Juggler provides a single network interface to applications that desire such simplicity, but provides a mechanism for applications to manage connectivity explicitly if they can benefit from doing so .However, the switching time of existing implementations is too high for some potential applications, and the It describes a link-layer implementation of a virtual 802.11 networking layer, called Juggler, that achieves switching times of approximately 3 ms, and less than 400 _s in certain conditions. We demonstrate the performance of this implementation on three application scenarios. By devoting 10 percents of the duty cycle to background tasks, Juggler can provide nearly instantaneous handoff between base stations or support a modest sideband channel with peer nodes of, without adversely affecting foreground throughput. Furthermore, when the client issues concurrent network flows, Juggler is able to assign these flows across more than one AP, providing significant speedup when wired-side bandwidth from the AP constrains end-to-end performance microseconds which is comparable to packet transmission times. A more practical method for concurrent channel usage is to use multiple radio interfaces and dedicate a separate radio channel to each.

II. EXISTING METHODS

A. Multi-radio mesh network:

In wireless communications each mesh node can use a single radio interface that is dynamically switched to a wireless channel indifferent frequency bands to communicate with different nodes. This however incurs frequent channel switching overhead of the order of 100s

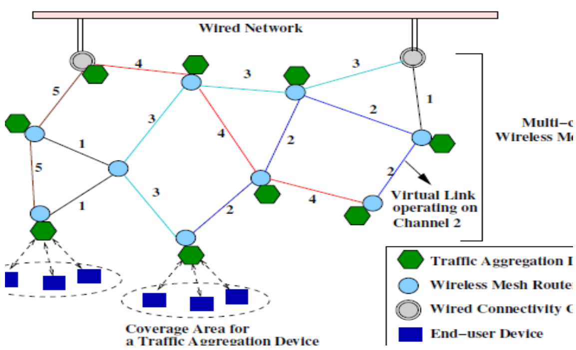

Figure2.1Multichannel Wireless Mesh Network

A multi-channel wireless mesh network (WMN) architecture (called *Hyacinth)* that equipment mesh network node with multiple IEEE 802.11 network interface cards (NICs). The central design issues of this multi-channel WMN architecture are channel assignment and routing.

The Hyacinth architecture consists of a multi-channel wireless mesh network (WMN) core, which is connected to a wired network through a set of wired connectivity gateways. Each WMN node has multiple interfaces, each operating at a distinct radio channel. A WMN node is equipped with a traffic aggregation device (similar to an 802.11 access point) that interacts with individual mobile stations. The multi-channel[5] WMN relays mobile stations' aggregated data traffic from the wired network. The links between nodes denote direct equipped with a traffic aggregation device (similar to an 802.11 access point) that interacts with individual mobile stations. The multi-channel [5] WMN relays mobile stations' aggregated data traffic from the wired network. The links between nodes denote direct communication over the channel indicated by the number on the link. In this example, each node is equipped with 2 wireless NICs. Therefore the number of channels any node uses simultaneously cannot be more than 2; the network as a whole uses 5 distinct channels.

Thus the intelligent channel assignment is critical to *Hyacinth*'s performance, present *distributed* algorithms that utilize only local traffic load information to dynamically assign

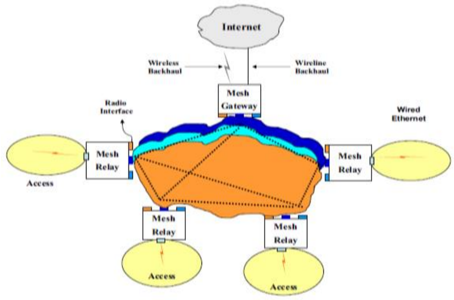

Figure 2.2.Multichannel Mesh Architecture

Channels and to route packets, and compare their Performance against a centralized algorithm that performs the same functions. Through an extensive simulation study, we show that even with just 2 NICs on each node, it is possible to improve the network throughput [10] by a factor of 6 to 7 when compared with the conventional single-channel ad hoc network architecture. We also describe and evaluate a 9-node *Hyacinth* prototype that is built using Commodity PCs each equipped with two 802.11a NICs.

III. CHALLENGING FACTORS

The design of routing metrics for wireless multi-hop networks is challenging due to following three unique characteristics of wireless links:

- *Time varying channels and resulting variable packet loss:* The wireless links suffer from short term and long term fading and result in varying packet loss over different time scales. When the distance between the communicating nodes is large or if environment is obstacle rich and causes fading, the loss ratio of the link can be high. A routing metric should accurately capture this time varying packet loss.

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 Packet transmission rate:
The packet transmission rate (or data rate) may vary depending upon the underlying physical layer technology. For example, 802.11a links have high data rate compared to 802.11b links. The data rate may also vary depending on the link loss characteristics when auto-rate control algorithms are used.
 Interference: Wireless links operating in unlicensed spectrum suffer from two kinds of interference:
(1) *Uncontrolled interference*
Results from non-cooperating entities external to the network that use the same frequency band but do not participate in the MAC protocol used by network nodes. For example, microwave ovens, Bluetooth devices operating in 2.4GHz ISM bands interfere with 802.11b/g networks in the same band.
(2) *Controlled interference:*
This kind of interference results from broadcast nature of wireless links where a transmission in one link in the network interferes with the transmissions in neighboring links. The interference of this kind depends on factors such as the topology of the network, traffic on neighboring links etc. It is well known that interference seriously affects the capacity of wireless networks in a multi-hop setting. It is important or a routing metric to capture the potential interference experienced by the links to find paths that suffer less interference and improve the overall network capacity.
Interference can be either intra-path, wherein transmissions on different links in a path interfere or inter-path interference or inter-path wherein, transmissions on links in separate paths interfere. A more channel diverse multi-hop path has less intra-flow interference which increases the throughput along the path as more links can operate simultaneously if they operate on different orthogonal channels. A good routing metric should find paths with component links that have low loss ratio, high data rate and experience low levels of interference.

A. Drawbacks of Existing mechanisms

Some of the drawbacks are listed as follows:
1. Channel Assignment [6],
2. Load Balance in Routing problem

IV. PROPOSED WORK

Juggler's design is based on Virtual Wi-Fi [9]. This system maintains a set of virtual networks that are each active on the Wi-Fi radio [23] in turn. When a virtual network is not active any outbound packets are buffered for delivery the next time the network is activated. Switching from one AP or ad hoc network to the next involves updating such wireless parameters as the SSID, BSSID (station MAC address), and radio frequency on the wireless card. Most Wi-Fi cards perform part of the IEEE 802.11 protocol in firmware rather than in a software device driver. The problem is that this does not support a scenario where it would be advantageous to change the radio frequency or SSID every 100ms. The firmware of such legacy cards often performs a card reset when changing certain wireless parameters. Virtual Wi-Fi reduced switching time from three or four seconds to 170 ms by suppressing the media connect/ disconnect messages that wireless cards generate when these parameters are changed. Otherwise, these notifications cause upper layers of the networking stack to believe that the network interface is briefly disabled, and no data can flow for several seconds they further reduced switching time to 25ms. When Native Wi-Fi cards were used. These are cards that perform the MAC layer in software, not on the card itself. The software device driver can therefore perform only those operations that are necessary, and omit any wasteful firmware resets. The Native Wi-Fi cards used in the evaluation of Virtual Wi-Fi still performed the 802.11 association procedure automatically in firmware whenever the network was rotated. Juggler uses wireless cards that rely on a software MAC layer. This lets us suppress the association process to further optimize switching. When Juggler first communicates with an AP, it must perform the slow 802.11 association sequence. Subsequently, Juggler only associates to an AP again if it receives an explicit 802.11 deauthentication message. This may occur if Juggler is associated with a given AP but rarely sends any data through that virtual network, since access points periodically deauthenticate "inactive" clients. Simultaneously is that packets destined for our device may arrive at an AP while the Wi-Fi radio is communicating with a different AP or ad hoc peer. Because the first AP does not know this, it will transmit data but the client's radio will not detect the packets because it is tuned to a different channel. Virtual Wi-Fi uses the 802.11 power saving mode (PSM) to coerce APs into buffering downstream packets intended for the client while the client is communicating with another AP or peer. In standard PSM operation, a client is connected to one base station but periodically deactivates its Wi-Fi interface to conserve power. Before turning off the Wi-Fi radio, the client sends a null IEEE 802.11 frame to the base station, with a PSM mode bit set. At a fixed frequency, the client reactivates its radio and listens passively for the AP's beacon frame. One field of the beacon—a Traffic Indicator Map (TIM)—indicates which of the many clients connected to the AP have buffered packets waiting for them. Clients are uniquely identified by an association ID (AID) previously received as part of the 802.11 association process.

V. CONCLUSIONS & FUTURE WORK

In this paper, we proposed a method to Mobile devices with multiple network interfaces enable to control by RF spectrum of frequency with uses software and many capabilities of value to users. Such benefits, however, are negated by added cost in terms of physical form factor, money, and energy consumption. Multiplexing one wireless radio across multiple virtual networks has been proposed as a solution, but there are several drawbacks to existing work in this area. Switching times may still be too high for certain potential applications, and application level interfaces too cumbersome for software developers to realize full benefit.

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