Demo Abstract: BSMX - Message Exchange between unassociated WLAN devices

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Abstract

Beacon-based Short Message eXchange (BSMX) is a system to exchange small-sized messages between unassociated WLAN devices. We implemented BSMX for the Android operating system and developed several applications to demonstrate the potential of our novel approach.

1 Introduction

Several mainstream wireless communication technologies are available on the market today. However, there exists no established and easy to use method to exchange packets between such devices without any infrastructure. On the one hand, there are technologies like UMTS and GSM, both using an area-wide infrastructure which is controlled by telecommunication companies. On the other hand, there are a huge number of Wireless LAN (WLAN) and Bluetooth devices most of which are used in private households. In case of UMTS, the telecommunication companies have no incentive that devices of their customers can communicate directly with each other without the usage of the companies' infrastructure and control. The situation of the second group of devices differs clearly, because WLAN and Bluetooth is typically self-governed by the device owners. Most mobile Bluetooth devices have a limited radio range and support only a small set of Bluetooth profiles. Therefore, we focus on further discussion about IEEE 802.11 devices that support configuration tools to build an ad-hoc network.

Although supported by IEEE 802.11, the ad-hoc mode that allows the direct communication from one device to other devices in radio range is rarely used in practice. We assume that the complex configuration of ad-hoc networks is the main reasons for the current situation. We are confident that the device configuration can be improved by adopting existing technologies, but today, the configuration is typically far too complex especially if multi-hop forwarding is required. Our conclusion is that the already widely-used mobile Internet connections via UMTS are sufficient to afford end-to-end communication between mobile devices. However, we assume that an easy to use 1-hop data exchange mechanism can generate a significant user benefit and enable new types of hybrid applications. For instance, an application can use the Internet for communication purposes and the

1-hop ad-hoc system to detect other application users in the proximity without utilizing GPS. The next section describes our novel approach for the easy to use 1-hop data exchange and our implementation. Finally, Section 3 describes our example applications for Android-based smartphones.

2 Beacon-based Short Message Exchange

The IEEE 802.11 standard defines a set of procedures to create, join and maintain WLAN networks. These mechanisms require additional packets that are not forwarded to the operating system. Furthermore, the standard allows manufacturer-specific components in most of these so called management packets. We have developed an IEEE 802.11-compliant extension that allows user space applications to add short messages to these management layer packets. Moreover, we also implement a mechanism that forwards such received additional user data to the related application. A major advantage of our proposed approach is that it does neither require a common SSID nor negotiated encryption settings or routing layer configurations. The idea is that devices like access points and smartphones can operate without changing their network and security configurations. We call this novel communication method *Beacon-based Short Message eXchange* (BSMX) [1].

Access points and ad-hoc network nodes send unencrypted beacon packets periodically, typically every 100 ms. Our approach can be utilized to add small-sized messages to these beacon packets which are sent independent from the current network load, anyway. We do not modify the radio channel, thus another device in radio range can only receive the message if it operates on a adequate channel. Mobile devices like smartphones typically run in client mode and hence they do not send beacon packets continuously. Nevertheless, these devices can send and receive messages by performing an active scan that is used to discover access points in the proximity. During such an active scan the device passes through all radio channels and sends so called probe request packets that are answered form receiving access points by returning a probe response packet. This procedure is utilized by our BSMX approach to exchange small-sized messages between devices that do not operate on identical radio channels. Most devices can conduct an active scan while they are connected to an access point and smoothly resume the connection after the scan.
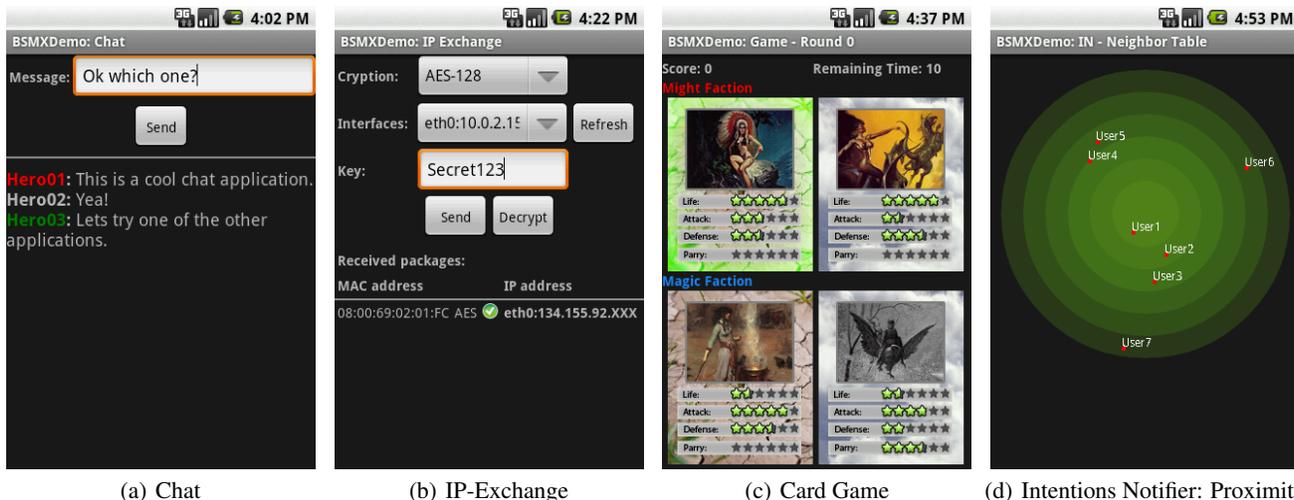
The implemented IEEE 802.11 extension can be linked

(a) Chat   (b) IP-Exchange   (c) Card Game   (d) Intentions Notifier: Proximity

Figure 1. BSMX Demonstration Applications

to every open source Linux driver for WLAN devices. Furthermore, the extension is designed in a way that allows the required additional modifications on the device driver itself to be limited. We have implemented the extension for the TNETW driver that is used by the majority of Android devices and also for the open source driver MadWifi which supports Atheros based chipsets. In addition to the driver extensions, we also developed a protocol daemon that communicates with the device driver extension via Netlink. The daemon implements the publish/subscribe pattern and enables applications to send and receive messages over the BSMX system. Furthermore, the daemon maintains a neighbor table that can be used by all applications. In the next section we will describe four demo applications that are built on top of the BSMX system.

3   BSMX Demo Applications

We developed four applications for the Android operating system that use our BSMX daemon to exchange messages over WLAN. The first and most obvious adoption is a chat application that allows the user to exchange text messages with other users in the proximity. Figure 1(a) shows a screenshot.

There is no addressing schema in the BSMX system itself and thus every message sent can be received by every device in radio range. If an application requires the addressing of a specific other device, the developer has to implement it within the application. We assume that most applications want to decide on the receiver side whether they are a recipient. The reader may want to keep in mind that with respect to the broadcast characteristic of the ether every transmitted message can already be received by every device in radio range. We *only* moved the decision if a packet will be dropped from the operating system to the application. For instance, the chat application can add a channel name to the messages and filter out all received messages that do not have the selected channel name.

Figure 1(b) shows a screenshot of the second demo application that allows users to exchange the public IP addresses of their mobile Internet connections. Also in this application, the destination device is not explicitly addressed. Instead, the user can enter a key that is used to encrypt the messages with AES. The application then tries to decrypt every received message with the entered key. This way it is possible to transmit the IP address to everyone in the proximity that knows the correct key. We assume that this simple method for the exchange of IP addresses can enable many novel applications.

The third demo application is a simple card game that can be seen in Figure 1(c). Each player can select one of four randomly generated game cards with different skills and properties during a predefined time window. After the time expire, every instance of the application sends the selected game card via BSMX to the other devices. The trick here is that the game sends only the seeds of all random generators used instead of the card itself. This information is sufficient for each instance to simultaneously calculate the winner of the round without further message exchange.

The fourth application is the *Intentions Notifier* that is shown at Figure 1(d). The idea is that people can cooperate or help each other by the execution of their intentions. For instance, an intention could be that you plan to drive by car to the next city and that you are willing to pick a trustworthy passenger in the near proximity. For this purpose, the application exchanges messages with a basic user profile and a user ID. If the device has Internet access, the received basic user profile can be extended by means of the complete profile that is stored on a webserver. If the profile matches the user selected search conditions, the user will be notified and can send a message to the other person. Furthermore, the application shows the multi-hop neighbor table of the BSMX daemon and highlights devices with matching profiles.

4   References

[1] S. Schnaufer, S. Kopf, H. Lemelson, and W. Effelsberg. Beacon-based short message exchange in an inner city environment. In *9th IFIP Annual Mediterranean Ad Hoc Networking Workshop (Med-Hoc-Net 2010)*, June 2010.