Mobile Multimedia Presentation in Self-Forming Mobile Device Groups: Ad-hoc Networks in Practice

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ABSTRACT

This demo exhibits a new application of mobile ad-hoc networks, where, a group of mobile devices are connected to allow synchronized presentation of multimedia content. The demo is in the form of an interactive tour. Participants have a mobile device and the tour is led by a guide, who takes the group on an informative tour of a locale. The tour is augmented with the presentation of multimedia content on the devices, highlighting points of interest. Content presentation is controlled by the guide and is synchronized using the ad-hoc network. This is an edutainment application but the underlying technology could be applied elsewhere including educational settings and in entertainment.

Categories and Subject Descriptors

K.3.1 [**Computers and Education**]: Computer Uses in Education - Collaborative Learning, Computer-Assisted Instruction

General Terms

Experimentation, Human Factors

Keywords

Multimedia, synchronization, groups, ad-hoc networks

1. THE PROBLEM

Forty years have passed since the genesis of wireless ad-hoc networking in 1972 with the US Department of Defense sponsored Packet Radio Network (PRNET) (later leading to the Survivable Adaptive Radio Networks program in the early 1980s) [**?**]. In the intervening years there has been a wealth of research in the area, and many new acronyms and initialisms such as MANET, VANET, AODV, OLSR etc. Applications put forward have included emergency, military, sensor, and community mesh networks. However, while research has been extensive, deployment and commercialization in these spaces has been comparatively stunted, particularly where mobile ad-hoc networking is concerned. *Why is this the case?* One answer is that there are open problems in mobile ad-hoc networking such as the lack of a capacity theory [**?**]. Another may be the lack of a "killer app"; applications such as word processors and spreadsheets brought computers into the mainstream years after their invention, the web did the same for the Internet; mobile ad-hoc networks have yet to enjoy a similar breakthrough. Vehicular ad-hoc networks have been a hot research topic for many years and seen by many as a "killer app" for mobile ad-hoc networking but this has not proven to be the case. Unfortunately the same open problems turn up in the vehicular space [**?**]. As a result, mobile ad-hoc networking research is at a crossroads; the open problems must be solved to allow a "killer app" to emerge or "killer apps" that circumvent the open problems must be found.

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2. THE OPPORTUNITY

In 1972, PRNET used a combination of ALOHA [**?**] and CSMA approaches for medium access [**?**]. Having seen use in mobile ad-hoc networking, ALOHA was to also prove influential in the cellular networks used by mobile phones. In contrast with mobile ad-hoc networks, cellular networks became a huge commercial success and have near omnipresence. In recent years mobile devices have seen phenomenal success and relentless development; today's smartphones and tablets are powerful, multi-functional, computers with multiple wireless data communication options. We live in a world where mobile computing devices with a range of wireless communication capabilities are all around us but mobile ad-hoc networks have yet to take off. The success of these devices is based on networks reliant on fixed infrastructure. This success throws the relative failure of mobile ad-hoc networks into relief but does it point to their demise?

Some applications touted for mobile ad-hoc networks can be performed using smart-phones. Smart-phones can gather much of the data necessary for intelligent transportation systems without vehicular ad-hoc networks. For example data collected by tracking mobile phones in vehicles is used to provide live traffic information for in-car satellite navigation systems. If cellular devices begin to perform some of the killer applications touted for mobile ad-hoc networking then is the prospect of an increase in deployment and commercialization likely? While one view is that mobile devices may render mobile ad-hoc networks largely obsolete, a counter argument can be made that the ubiquity of these devices presents an opportunity for mobile ad-hoc networks. If compelling applications of mobile ad-hoc networks can be developed for deployment on these devices then mainstream acceptance and commercialization may follow.

We believe the success of mobile devices provides an opportunity for mobile ad-hoc networks. However, the open problems remain and therefore applications where they do

not apply must be put forward. In [?] Ramanathan et al. do just this by highlighting that while influential information-theoretic results point to mobile ad-hoc networks being asymptotically unscalable [?], they can be adequately scalable for certain applications (in their case a military one).

The same can be true on mobile devices, where, mobile ad-hoc networking applications are beginning to emerge. It is in this context that we propose a technical demonstration of a novel new application of mobile ad-hoc networking on mobile devices for a multimedia education/edutainment application. This demonstration uses mobile ad-hoc networks to present multimedia on a group of mobile devices in synch at the behest of a person in control.

3. THE DEMO

What is shown? The demo is in the form of a short guided tour and uses smart-phones. Visitors to the demo are given devices and led on a short guided tour. There is one tour-guide device and can be upwards of 20-30 visitor devices. During the tour, the guide triggers multimedia content on guest devices using his/her own device. This content augments the story told on the tour, further highlighting points of interest and can include images, audio, video and apps.

The demo has been successfully trialled at the poster session of an internal research day. Multimedia content such as videos of research in action, data visualizations, TV appearances and maps of research work locations was gathered from researchers and used to create a short guided tour of some highlights of the research at the poster session. This setup can be replicated to create a demo that gives a short tour of our research centre or the same process repeated with researchers at ACM MM'12 to give a custom demo.

When the tour is over, visitors are given a demonstration of a how the technology may have other novel uses in an educational context. This finale shows how multiple devices can be used to teach the concept of instrumentation in a music class. First, all devices play a piece of music on one instrument, this is done three times for three different instrument types e.g. string, woodwind, brass. Finally, all devices combine to play the same piece as an orchestral ensemble with each device playing a different instrument.

How does it work?

- Wi-Fi is used for data communications
- olsrd (optimized link state routing protocol daemon) is used to form a self-organising-and-healing network
- Master device acts as DHCP server (allocates IP addresses automatically)
- Can act as a gateway to the internet, provide simple security (WEP/WPA and MAC-address whitelisting)
- Devices communicate according to a simple protocol
- Client app sends instructions e.g. display image X
- Server runs on other devices waiting for instructions
- On receipt, a simple parser interprets what to do
- Instructions are carried out synching all devices on a given action e.g. display image X

4. CONCLUSION

Mobile ad-hoc networks are under-deployed despite years of research. Open problems remain, particularly around scalability, but there are applications where they are adequately scalable. This demonstration shows one such application that provides a novel multimedia experience.

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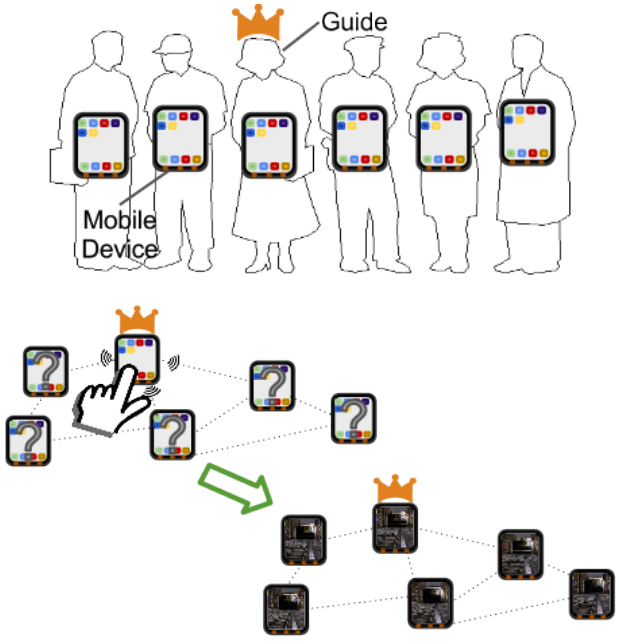

Figure 1: Tour group with devices, guide choses multimedia content this is then shown on all devices