

Marlene H. Dortch, Secretary,
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: Notice of Ex Parte Presentations - Wireless E911 Location Accuracy Requirements,
PS Docket 07-114

On July 10th, 2013, Jie Liu (Principal Researcher) and Dimitrios Lymberopoulos (Researcher) from Microsoft had a conference call with Henning Schulzrinne (FCC Chief Technology Officer), Erika Olsen, Timothy May, David Siehl, Dana Zelman, and Jerome Stanshine (FCC's Public Safety and Homeland Security Bureaus). A follow up phone call between Jie Liu and David Siehl was on Aug. 20th, 2013. The topic was around indoor location technologies and how they may perform in E911 scenarios.

Microsoft researchers gave an overview of current indoor location technologies implemented on mobile phones, such as using WiFi signatures. The dense deployment of WiFi access points make it possible to use WiFi visibility or signal strengths as location signatures. However, WiFi signals can change significantly due to replacement of access points, power management, and interference from other devices operating at the same frequency. Of course, installing dedicated infrastructures will help.

FM radio signals, on the other hand, are at a much lower frequency, and can penetrate building easily. Small objects, such as human motion and furniture re-arrangements do not change FM signals much, yet floors and walls create structure that the signals bounce off. In addition, existing FM infrastructure is available widely.

In 2011, researchers at Microsoft Research (MSR) has conducted a research project to use FM signal properties, such as signal strengths, multiple paths, and frequency drift, as location signatures. From data collected at an office building, a shopping mall, and an apartment, FM signature alone, gives ~90% accuracy of room level location identification. When combining with WiFi signatures, the accuracy improves to 98%. FM signals are stable over time. That is, signatures collected about a month earlier can still produce 85%+ location accuracy, while WiFi signatures need more frequent profiling. This result is published in *The 10th International Conference on Mobile Systems, Applications, and Services (MobiSys 2012)* [1].

In Microsoft's experiments, the system can distinguish locations from two sides of a wall, even though they are only less than a foot apart. This is very hard to achieve using WiFi-based signatures.

Questions were asked on how to collect the signatures in the first place. This is a challenge for all signature based approaches. For public spaces, it is possible to profile them with dedicated devices. In private homes, we may rely on people's frequent visit patterns. A question was about the privacy concerns associated with profiling. The risk exists. At least in public spaces, if the profiling system remove user or device IDs from the collected data, it is hard to find out who is at the location. There are other indoor location mechanism, such as using inertial navigation, sound signatures, magnetic infrastructure or magnetic field information. Ultimately, the solution may reside on fusing data from multiple kinds of sensors.

Reference:

[1] Yin Chen, and Dimitrios Lymberopoulos, Jie Liu, and Bodhi Priyantha, "FM-based Indoor Localization," *The 10th International Conference on Mobile Systems, Applications, and Services (MobiSys 2012)*, Low Wood Bay, Lake District, United Kingdom, June 2012.

<http://research.microsoft.com/apps/pubs/default.aspx?id=163038>