死胖兽温馨提示：这是第三大题论文翻译部分的部分段落，原文是”RADAR：An In-Building RF-based User Location and Tracking System” 可在年级群群文件里下载！

1．The proliferation of mobile computing devices and local-area wireless networks has fostered a growing interest in location-aware systems and services. In this paper we present RADAR, a radio-frequency (RF) based system for locating and tracking users inside buildings. RADAR operates by recording and processing signal strength information at multiple base stations positioned to provide overlapping coverage in the area of interest. It combines empirical measurements with signal propagation modeling to determine user location and thereby enable location-aware services and applications. We present experimental results that demonstrate the ability of RADAR to estimate user location with a high degree of accuracy.

移动计算设备和本地区内的无线网络的增长已培养出了对位置感知系统和服务的越来越浓厚的兴趣。在这篇文章中我们讨论雷达，无线电频率（射频）系统，这套系统定位与跟踪建筑物内的用户。我们通过记录和处理的信号强度信息操作雷达，通过多基站定位，以提供重叠覆盖在该地区的定位信息。它结合基于经验的测量与信号传播模型，以确定用户的位置，从而提供位置感知服务和应用。我们目前的实验结果表明这样的雷达系统有能力以高度的准确性来估计用户的位置。

2．The proliferation of mobile computing devices and local-area wireless networks has fostered a growing interest in location-aware systems and services. A key distinguishing feature of such systems is that the application information and/or interface presented to the user is, in general, a function of his or her physical location. The granularity of location information needed could vary from one application to another. For example, locating a nearby printer requires fairly coarse-grained location information whereas locating a book in a library would require fine-grained information.

移动计算设备和本地区内的无线网络的增长已培养出了对位置感知系统和服务的越来越浓厚的兴趣。一个重要特点是这类系统是应用信息和/或界面提交给用户，一般来说主要是他或她的物理位置。所需要的位置信息的粒度从一个应用到另一个来说可能是大不一样的。举例来说，寻找一台附近的打印机，需要相当粗粒度的位置信息，而在一个图书馆里定位的一本书，将需要细粒度信息。

3．While much research has focused on developing services architectures for location-aware systems (e.g., [Maa97,Nel98]), less attention has been paid to the fundamental and challenging problem of locating and tracking mobile users, especially in in-building environments. The few efforts that have addressed this problem have typically done so in the context of infrared (IR) wireless networks. The limited range of an IR network, which facilitates user location, is a handicap in providing ubiquitous coverage. Also, the IR network is often deployed for the sole purpose of locating people and does not provide traditional data networking services. To avoid these limitations, we focus on RF wireless networks in our research. Our goal is to complement the data networking capabilities of RF wireless LANs with accurate user location and tracking capabilities, thereby enhancing the value of such networks.

而这方面的研究主要重点集中在了为位置感知系统（例如， [ Maa97，Nel98 ] ）开发服务体系结构，不大注意一些根本性和具有挑战性的问题如定位与跟踪移动用户，尤其是一个封闭性的建筑环境内的用户。由于帮助用户定位红外网络使用范围的局限性，在提供无所不在的覆盖面上来说是一个缺陷。此外，红外网络往往是只被部署来定位用户的，而没有提供传统的网络数据服务。为了避免这样的局限性，我们专注于研究射频无线网络。我们的目标是为实现基于射频无线局域网的网络数据和准确的用户定位和跟踪能力，从而提高网络的使用价值。

4．In this paper, we present RADAR, an RF-based system for locating and tracking users inside buildings. RADAR uses signal strength information gathered at multiple receiver locations to triangulate the user’s coordinates. Triangulation is done using both empirically-determined and theoretically computed signal strength information.

在本论文中，我们讨论雷达——射频系统，这套系统定位与跟踪建筑物内的用户。雷达利用聚集在多个接收地点的信号强度信息，以得到用户三维定位坐标。这个坐标是根据基于经验和从理论上计算出信号强度的信息来确定的。

5． Our experimental results are quite encouraging. With high probability, RADAR is able to estimate a user’s location to within a few meters of his/her actual location. This suggests that a large class of location-aware services can be built over an RF local-area wireless data network.

我们的实验结果很鼓舞人心。雷达能高效率地估计一个用户的位置，而这个位置只和他/她的实际位置只相差数米的距离。这表明，大量的位置感知服务可以部署在基于射频的无线数据网络上。

6．The remainder of this paper is organized as follows. In Section 2, we survey related work in location determination technologies. In Section 3, we discuss our research methodology. Section 4 contains the core of the paper where we present and analyze the empirical and the signal propagation modeling methods. A discussion of extensions to the base RADAR system appears in Section 5. Finally, we present our conclusions in Section 6.

本文的其它部分的组织结构如下：在第2节中，我们纵览关于位置测定的技术。在第3节中，我们讨论研究的方法。而论文第4节的核心内容在于分析经验性的和信号传播的建模方法。关于基地雷达系统的扩展讨论出现在第5节。最后，我们在第6节中得出我们的结论。

7． In this paper, we have presented RADAR, a system for locating and tracking users inside a building. RADAR is based on empirical signal strength measurements as well as a simple yet effective signal propagation model. While the empirical method is superior in terms of accuracy, the signal propagation method makes deployment easier. We have shown the despite the hostile nature of the radio channels, we are able to locate and track users with a high degree of accuracy. The median resolution of the RADAR system is in the range of 2 to 3 meters, about the size of a typical office room. Our results indicate that it is possible to build an interesting class of location-aware services, such as printing to the nearest printer, navigating through a building, etc., on an RF wireless LAN, thereby adding value to such a network. This, we believe, is a significant contribution of our research. Our eventual plan is to combine location information services with the RADAR system and deploy this within our organization.

在这篇文章中，我们已经介绍了雷达RADAR:一种基于射频的室内用户定位和跟踪系统。雷达是基于经验性的信号强度测量以及一个既简单又有效的信号传播模型。而实验法在精度上是非常高的，信号传播的方法使部署更加容易。我们已经证明了，尽管存在其它电台频道信号的干扰，我们都可以以高度的准确性定位和跟踪用户。雷达系统的平均覆盖范围为2至3米，大小约一个典型的办公室的样子。我们的研究结果表明，基于射频无线局域网建立一个有趣的分类的位置感知服务的可行的，如利用最临近的打印机提供打印服务，建筑物内的导航等，从而增加了局域网的使用价值。我们认为，我们的研究是一个重大的贡献。我们的最终计划是要在我们组织内的位置信息服务与雷达系统和部署结合起来。

8．The proliferation of mobile computing devices and local-area wireless networks has fostered a growing interest in location-aware systems and services. In this paper we present RADAR, a radio-frequency (RF) based system for locating and tracking users inside buildings. RADAR operates by recording and processing signal strength information at multiple base stations positioned to provide overlapping coverage in the area of interest. It combines empirical measurements with signal propagation modeling to determine user location and thereby enable location aware services and applications. We present experimental results that demonstrate the ability of RADAR to estimate user location with a high degree of accuracy.

移动计算设备和局域网无线网络的激增促成了对位置感知系统和服务越来越大的兴趣。在本文中，我们提出RADAR，一个基于射频的系统来定位和跟踪在一个建筑物中的用户。RADAR通过记录和处理在多个基站上的信号强度信息来操作的。这些基站被定位来提供我们感兴趣区域的重叠覆盖。它结合了经验测量和信号传播模型来确定用户的位置，从而使位置感知服务和应用成为可能。我们给出实验结果，这个结果能证明RADAR以一个高准确率来估计用户位置的能力。

9．In this paper, we present RADAR, an RF-based system for locating and tracking users inside buildings. RADAR uses signal strength information gathered at multiple receiver locations to triangulate the user’s coordinates. Triangulation is done using both empirically-determined and theoretically computed signal strength information.

在本文中，我们提出RADAR——一个为了在室内（建筑物内）定位和跟踪用户的基于RF的系统。RADAR使用从多个接收器位置收集到的信号强度信息来对用户坐标进行三角测量。三角测量是通过经验决定和理论计算信号强度信息来双重完成的。

10．Related work in the area of user location and tracking falls into the following broad categories: (1) in-building IR networks, (2) wide-area cellular networks (based on RF),and (3) Global Positioning System (GPS).

在用户定位和跟踪领域的相关工作可以分为以下几大类：（1）室内IR（红外）网络，（2）广域蜂窝网络（基于RF）和（3）全球定位系统（GPS）。

11．The Active Badge system [Wan92,Har94] was an early and significant contribution to the field of location-aware systems. In this system, a badge worn by a person emits a unique IR signal every 10 seconds. Sensors placed at known positions within a building pick up the unique identifiers and relay these to the location manager software. While this system provides accurate location information, it suffers from several drawbacks: (a) it scales poorly due to the limited range of IR, (b) it incurs significant installation and maintenance costs, and (c) it performs poorly in the presence of direct sunlight, which is likely to be a problem in rooms with windows.

主动徽章系统[Wan92，Har94]是一个早期的和对位置敏感系统有明显贡献的系统。在这个系统中，人所佩戴的徽章没10s发射出一个唯一的红外信号。放置在建筑物里已知位置的传感器获得唯一标识符，并且转播这些给定位管理软件。虽然这个系统提供准确的位置信息，它也忍受一些缺点：（a）由于红外的有限的范围，它测量的范围就很匮乏，（b）它会导致大量的安装和维护费用，以及（c）在阳光直射的情况下，它效果不佳，这可能是在有窗户房间里出现的一个问题。

12．Another system based on IR technology is described in[Azu93]. IR transmitters are attached to the ceiling at known positions in the building. An optical sensor on a head mounted unit senses the IR beacons, which enables the system software to determine the user's location. This system suffers from similar drawbacks as the Active Badge system.

在[Azu93]中描述了另一个基于红外技术的系统。红外发射器被安装在建筑物内天花板上已知的位置上。一个头戴式单位上的光学传感器感知红外信号，这些信号使得系统软件能决定用户的位置。这个系统和主动徽章系统有相似的缺点。

13．The system described in [ATC97] is based on pulsed DC magnetic fields. Multiple sensors are placed on body mounted peripherals, such as data gloves, and their output is processed to determine a person's location and orientation with a high degree of precision. This technology is used extensively in the computer animation industry. It is, however, quite expensive and, like IR, severely range limited, hence unsuitable for large-scale deployment.

在[ATC97]中描述的系统是基于脉冲的直流电磁场。多个传感器被放置在如数据手套类的身体的外设上，而传感器的输出被处理并以高度的精确性决定一个人的位置和方向。这种技术被广泛的应用于计算机动画产业。然而，这是非常昂贵的，而且就像红外，它也有严格的范围限制。因此不适合大规模部署。

14．Recently, several location systems have been proposed for wide-area cellular systems [Tek98]. The technological alternatives for locating cellular telephones involve measuring the signal attenuation, the angle of arrival (AOA),and/or the time difference of arrival (TDOA). While these systems have been found to be promising in outdoor environments, their effectiveness in indoor environments is limited by the multiple reflections suffered by the RF signal, and the inability of off-the-shelf and inexpensive hardware to provide fine-grain time synchronization.

最近，提出了几个对大面积蜂窝系统[Tek98]的定位系统。对定位移动电话的可选择的技术包括测量信号的衰减，到达的角度（AOA）和/或者达到的时间差（TDOA）。然而这些系统被认为是在室外环境是有希望的，它们的在室内环境的有效性被限制了，因为对RF射频信号的多次反射。以及，现成的和廉价的硬件没有能力提供细粒度的时间同步。

15．Systems based on the Global Positioning System[GPS99], while very useful outdoors, are ineffective indoors because buildings block GPS transmissions.

在室外非常有用的基于全球定位系统的系统[GPS99]在室内就会失效，因为建筑物阻挡了GPS传输。

16．The Daedalus project [Hod97] developed a system for coarse-grained user location. Base stations transmit beacons augmented with their physical coordinates. A mobile host estimates its location to be the same as that of the base station to which it is attached. Consequently, the accuracy of the system is limited by the (possibly large) cell size.

Daedalus（代达罗斯）工程为粗粒度用户定位开发了一个系统。基站传输用它们的物理坐标扩张的信号。移动主机估计它的位置和它连接的基站的位置是一样的。因此，系统的精确性被（可能大）细胞大小所限制了。

17．Our work differs from previous work in that we tackle the problem of user location and tracking on a widely available radio frequency based wireless network in an in building environment. RF networks offer a significant advantage over IR networks in terms of range, scalability, deployment, and maintenance. With speeds of up to 11Mbps, these systems have gained rapid acceptance and are being widely deployed in offices, schools, homes, etc.

我们的工作和以前工作的不同点在于我们解决用户定位和跟踪的问题用一个广泛使用的基于无线网络的射频方法在一个室内环境。射频网络在范围上、可扩展性、部署和维护上都比红外网络有很重要的优势。当速度高达11Mbps时，这些系统都能获得很快的接受，而且已经广泛部署在办公室、学校、家庭中，等等。

18．We recently became aware of the Duress Alarm Location System (DALS) described in [CG93]. While their work and ours are similar in some ways, they also differ insignificant ways. Briefly, their system (1) is dependent on specialized hardware, (2) does not use propagation modeling to build a radio map of the building, (3) does not factor in user body orientation, and (4) requires infrastructural deployment over and above a wireless data network. These points are clarified in the following sections.

我们最近开始注意在[CG93]中描述的DALS胁迫报警定位系统。虽然他们的工作和我们的在很多方面都很相似，但他们也各有不同的重要途径。简单地说，他们的系统（1）都是依赖于特定的硬件，（2）没有使用传播模型来构建建筑的一个无线地图，（3）没有将使用者身体朝向作为因素，以及（4）需要在一个无线数据网上和之上部署基础设施。这些点会在下面的部分中阐述的。

19．We begin with a description of our experimental test bed. We then discuss the data collection process, including tools we developed for this purpose. Finally, we describe the processing we performed on the data as a precursor to the analysis described in Section 4.

我们以我们的实验测试环境的描述开始。我们然后讨论数据收集过程，包括我们为了这个目的而开发的工具。最后，我们描述我们在数据上执行的过程作为在第四部分描述的分析的预处理。

20．Our experimental test bed is located on the second floor of a 3-storey building. The layout of the floor is shown in Figure 1. The floor has dimension of 43.5 m by 22.5 m, an area of 980 sq. m (10500 sq. ft.), and includes more than 50rooms.

我们的实验测试环境是在三层建筑中的第二层上。该层的布局如图1所显示。该层的尺寸是43.5米乘以22.5米，面积为980平方米（10500平方尺），而且包含多余50个房间。

21．We placed three base stations, BS1, BS2 and BS3, at the locations indicated in Figure 1. Each base station was a Pentium-based PC running FreeBSD 3.0 equipped with a wireless adapter. Our mobile host, carried by the user being tracked, was a Pentium-based laptop computer running Microsoft Windows 95.

我们放置三个基站BS1,BS2,BS3在图1中显示的地方。每个基站都是基于奔腾的运行FreeBSD3.0的PC机并装备了一个无线适配器。由被跟踪的用户带着的移动主机是一个基于奔腾的膝上计算机运行着微软Window95操作系统。

22．Each base station and the mobile host was equipped with a Digital Roam About TM network interface card (NIC),based on Lucent’s popular Wave LANTM RF LAN technology.

每个基站和主机都配有一个数字Roam About网络接口卡（NIC）,基于朗讯的流向波局域网射频局域网技术。

23．The WAF propagation model provides a cost effective means for user location and tracking in an indoor RF wireless network. The model is cost effective in the sense that it does not require detailed empirical measurements to generate a signal strength map and consequently has a low set up cost. A significant result from Section 4.2.2 is that the parameters for the wall attenuation propagation model are similar across base stations despite the latter being indifferent locations. This suggests that the entire system can be relocated to a different part of the building, but the same parameter values can be used to model propagation and thereby determine a user’s location.

该WAF(Wall Attenuation Factor)传播模型为用户提供了一个有效的方法在室内无线射频网络进行定位和跟踪。该模型是符合成本效益意识，它不要求详细的实证测量产生的信号强度图，并因此具有低设立成本。从第4.2.2获得显着的成绩是为墙衰减传播模型设置的参数都是相似的基站，尽管后者在不同的地点。这表明，整个系统可以搬迁到建筑物内不同的地方，但相同参数值，可以用来进行模型传播，从而确定使用者的位置。

24．We discuss extensions to the RADAR system that would help improve its robustness and accuracy. Due to space constraints, we keep our discussion brief.

我们讨论扩展到雷达系统，该系统将有助于改善其鲁棒性和准确性。由于空间限制，我们保留我们的讨论简短。

25．We are investigating how user-mobility profiles can supplement signal strength information in locating and tracking users. A profile specifies a priori likelihood of user location and/or movement patterns, which can be derived from history [Liu98], calendar information, building layout,etc.

我们正在探讨如何为用户移动剖面可以补充信号强度信息，当其在定位和跟踪用户的时候。概况指定的是一个先验的可能性用户的位置和/或运动模式，这可以来自历史[ liu98 ] ，日历信息，建筑布局等。

26．We are also investigating base station-based environmental profiling to make RADAR robust in the face of large-scale variations in the RF signal propagation environment (caused, for instance, by the varying number of people in a building during the course of a day). Instead of recording just one set of signal strength measurements, we record multiple sets at different times of the day. The base stations probe the channel periodically to determine the current conditions, and accordingly pick the data set that is most appropriate for these conditions.

我们也正在调查基地站为基础的环境概况，在射频信号传播环境面对大规模的变化使雷达强劲（原因，例如，由不同数量的人在一个大楼的经历一天）. 代替记录一组信号强度测量结果，我们在每天不同时段纪录多套。基站探索频道定期确定当前的情况，并据此选择最适合于这些条件数据集.