Wireless Distributed Networks for Computers and Real World

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1. Introduction
In wireless distributed networks (WDNs), a lot of nodes are deployed in a target area, and they construct a wireless network by an autonomously distributed manner. Furthermore, a packet is transmitted from a source node to a destination node via some relay nodes even if it cannot reach the destination directly. WDNs have some useful applications such as ad hoc networks, wireless mesh networks, and sensor networks. These wireless networks attract much attention for their flexibility and extensibility. This presentation introduces technologies and applications of the WDNs.

2. Ad Hoc, Mesh and Sensor Networks
An ad hoc network is a network which is organized by wireless nodes such as lap-top PCs (Personal Computers), handheld game consoles, by an autonomously distributed manner, and does not need specific infrastructure. Usually, wireless nodes move, then, it is also called a mobile ad hoc network. A mesh network is also a self-organized network. Unlike the ad hoc network, wireless nodes are stationary located, and construct network infrastructure by these wireless nodes. The ad hoc and mesh networks generally employ IEEE 802.11 wireless LAN (Local Area Network) as wireless interfaces.

A sensor network consists of tiny sensor nodes, which are equipped with sensor devices and wireless interfaces. A lot of sensor nodes are distributed in a sensing field, and a fusion center gathers the sensing results by wireless. The sensor network can sense not points but space. It brings a novel paradigm that can sense a real world, recognize it from the sensing data and actuate devices.

3. Technologies for Wireless Distributed Networks
An important issue of the WDNs is how to deliver information with high efficiency and/or high reliability. So as to solve this issue, a lot of routing and error recovery technologies are developed so far.

In the WDNs, information is transmitted from a source node to a destination node via some relay nodes even if it cannot reach the destination node directly. Routing is a technology that it collects the information required for routing, and selects a path based on the collected information. It is important for routing to select the good path, considering the communication quality of wireless links.

In wireless communications, transmission errors frequently occur due to noise, radio propagation phenomenon such as fading, and interference from other nodes. Therefore, a lot of error recovery schemes such as cooperative transmissions, route diversity and opportunistic transmission are considered for the WDNs.
4. Applications
There are a lot of applications for the WDNs. Infrastructure for smart grid is a notable application in recent years. Home networking, environment monitoring, wildlife ecology observation systems, agriculture support system, disaster prevention/recovery systems, intelligent transportation systems, etc., are also interesting applications. The following system is an application of the WDNs for an emergency communication system in large-scale disasters.

In large-scale earthquakes, such as the Great East Japan Earthquake in 2011, communication infrastructures are destroyed in a disaster area, and information for victim help, disaster area, etc., cannot be exchanged. So as to solve this problem, an ad hoc network using balloon, “SKYMESH,” was proposed to provide a temporary network for emergency communication systems 0. In SKYMESH, balloons which are equipped with wireless nodes are located at 50-100 m high over the ground, and an ad hoc wireless network is constructed by these balloon nodes in the sky. Because balloon nodes can easily keep line-of-sight with their neighbor nodes, this system can cover a disaster area effectively. SKYMESH can provide some applications such as remote monitoring system, disaster message board service, etc.

5. Conclusions
This presentation has explained the ad hoc, mesh, and sensor network technologies as the WDNs, and introduced various their applications, e.g. smart grid, environment monitoring, and emergency communication systems. The WDNs can connect computers and real world, and will bring us a novel ICT (Information and Communication Technology) society.

References: