Wireless Sensor Network Suitability in Logistics

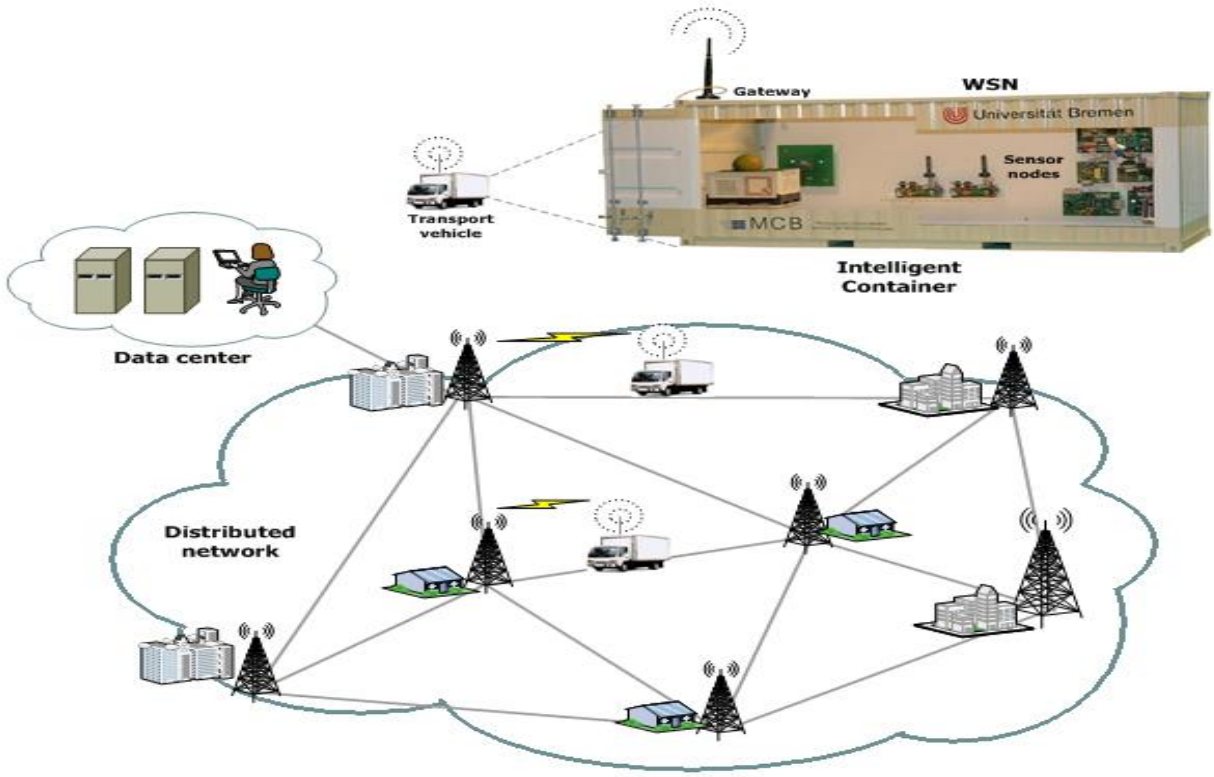

Figure 1:
Intelligent transport system

A logistics network consists of many entities, such as suppliers, factories, warehouses and distribution centers through which raw materials are acquired, transformed, produced and delivered to the customers. Each of them has a different information management system, and does not easily share information with each other. Moreover, the current logistics networks cannot automatically provide enough information about goods to enable full management.

Nowadays, the shortest path problem from the departure place to the destination should also be considered in the condition of lacking information from transportation vehicles, such as position and quality of goods. Besides, time limitation is another problem in logistics when giving a final decision for an event. Therefore, a good solution is not the best solution, but an acceptable one in a given time. On the other hand, decisions must be made as quickly as possible.

Having advantages such as mobility, low power, multi-hop routing (e.g. AODV, DSR, DYMO), low latency, self-administration, autonomous data acquisition and exchange, and fault tolerance, WSNs (Wireless Sensor Networks) allow centralized management up to item-level. By this, information about goods quality, flow, or any event happening with goods can be easily shared between suppliers and customers. Therefore, applying WSNs to logistics can reduce a great deal of manual work and enhance an intelligent transport system (shown in Fig.1) in which information collection and communication play an important role.

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Methodology

In the current logistic network, given the complexity of modeling and implementation, not many studies have been conducted with regard to implementing WSNs. To date, the existing approaches are to apply these new technologies only in certain processes of logistics. For example: tag/RFID is embedded in the packages so that they can easily be managed when put in the container or removed from it.

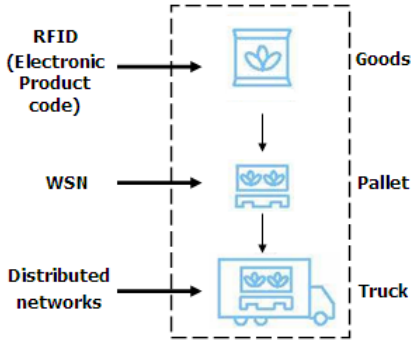

Figure 2: Mapping model

By mapping each layer in logistics to an appropriate technology (shown in Figure 2), the goods can be dynamically controlled and managed during the transport time.

The current low-cost nodes (e.g. Telos, Micaz motes) with embedded sensors (e.g., temperature, humidity, and pressure sensors) based on sensor operating systems (e.g. TinyOS, SOS), will be programmed to monitor the condition of packages in transport vehicles and report the status to the data center (centralized or distributed) on route from the departure location to the destination. Any problem or activity happening with goods on the way will be reported via available distributed networks to which the transport vehicle can connect (e.g. UMTS/GPRS, WLAN, WiMax).

Sensing data and reporting them to the data center, WSNs provide a platform to channel information from remote sites back to the data center via the gateway.

Based on this, the proper decisions can be made if unexpected events happen.

Researchers worldwide have proposed some effective mechanisms for WSNs to support two-way and many-to-one communication. With this, WSNs can support the management of many features (e.g. items quantity, goods quality, dynamicity) for described logistic scenarios.

The model of general system is shown in Figure 3, and it can be applied to transport systems in planes, ships, or trucks.

Normally, the container can use the gateway to communicate with available distributed networks with which it can connect. If no network is available (e.g., when planes or ships are in locations that the wireless networks can not cover), it can use SCE (Satellite Communication Equipment) module to transmit data via satellites if necessary.

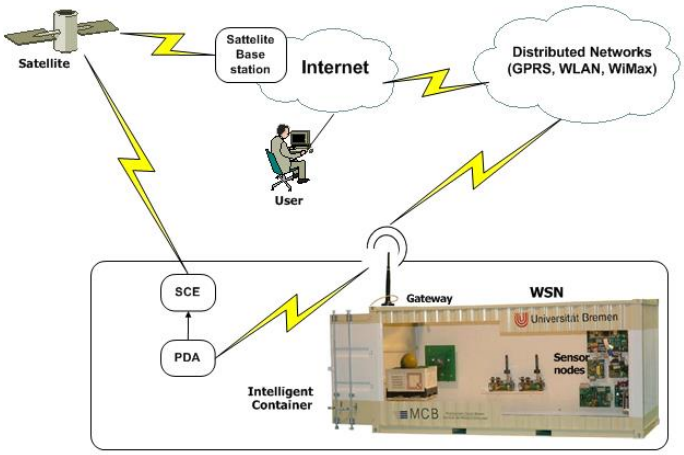

Figure 3: General overview of a transport system using WSNs

By the complete modeling of WSNs for logistic applications and verifying their implementation in real transport systems in trucks, a lot of issues (e.g remote management, delay requirements, load optimization, capability of remote tracking) can be solved on the way to reaching an intelligent transport system for the future.

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