



## RFID wired and wireless tracking system

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RWTS is a RFID based equipment tracking, management and anti-theft system

### 1. System Description

The system is consists of four units: the RFID tag, the detector, a web-connected database and a central station.

The system can compatible any kind of RFID: passive or active, high frequency or low frequency. One can choose the solution according to the client requirements.

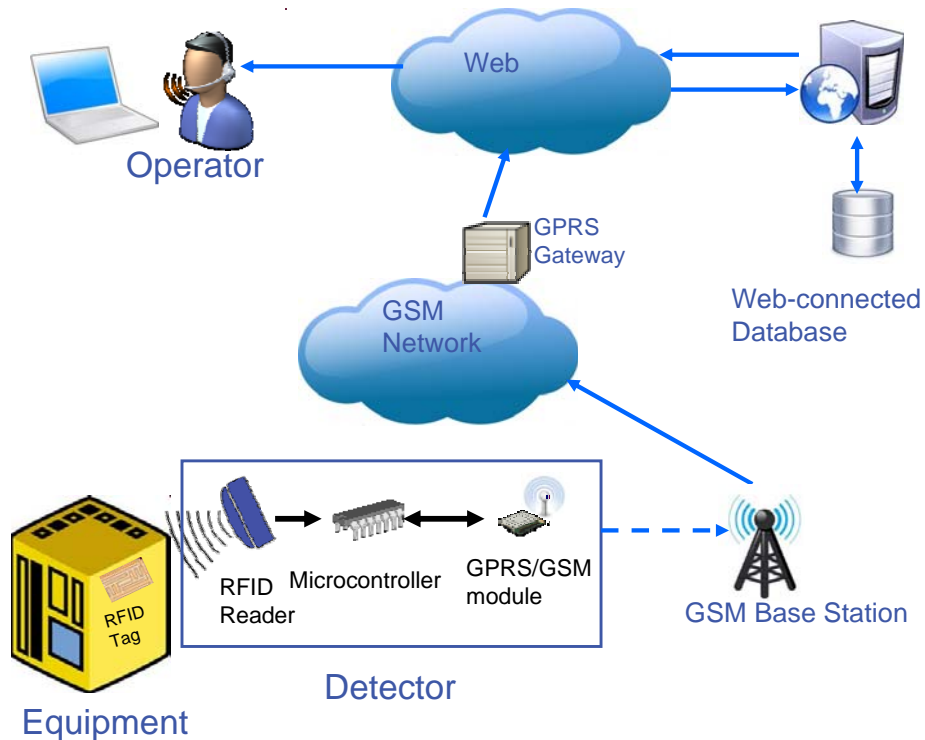


Fig. 1

#### 1.1 RFID tag

The RFID tag can be passive or active, but it must be firmly attached to the equipment, if someone forcefully removes the tag from the equipment, the tag will be damaged.

#### 1.2 Detector

The detector has three sub units: the RFID reader, the microcontroller and a wireless



communication module such as GPRS/GSM data terminal.

### 1.2.1 RFID reader

The RFID reader continuously reads the information of the tag and outputs the information to the microcontroller. When the multi readers or the multi tags are integrated in the system, the signal collision avoidance algorithm (IKM patent) is used to keep the identification correct.

### 1.2.2. Microcontroller

The microcontroller interfaces with the RFID reader and with the different wired and wireless communication modules; so that the microcontroller can send the RFID collected information to the web-connected database continuously under the normal operation. In the emergency situation, such as possible theft detected, the microcontroller can raise the alarm signal to the central station immediately and directly.

The microcontroller implements continuous link diagnostic verification with the central station to guarantee the communication with the central station. Since most of the nowadays microcontroller has the built-in wired communication ports (Ethernet), the wired communication module is not considered as a separate unit. The microcontroller should have the capability to generate sound and/or light alarm for emergency situations. The response operators' phone or cellar phone numbers are saved in the microcontroller for the emergency mode, so the operators can be contacted immediately.

### 1.2.3 Wireless communication module

Since wireless communication is better solution against breaking-and-entry, so a combination of the wired and the wireless communication is recommended for the anti-theft application. The detector can have various choices for the wireless communication modules: WiFi, GPRS, WiMax and so on, but taking the the cost and the communication range factor into consideration, GPRS is recommended.

### 1.2.4 Alternative power supply

The detector has an alternative power supply source in the form of a battery. The detector is powered from the AC power supply under the normal circumstance. However, when the AC power supply is interrupted, the battery can power the detector for several hours on it own. During that time, the detector sends the power supply interrupted information to the central station so actions can be taken by the



operator. The power supply interrupted event will also be recorded in the website connected database.

### 1.3 Web-connected Database

All data related to the equipments being tracked are stored in the web-connected database for the post-processing. The various types and sizes of database can be selected depending on the client demands.

### 1.4 Central station

The central station is the computer terminal for displaying the information of equipments being tracking via text or via graphics. The other function of the central station is to respond to the emergency situations, should they arise.

## 2. System operation

The system has three operation modes: the normal mode, the emergency mode and diagnostic mode.

### 2.1 Normal operation

In the normal operation mode, the RFID reader continuously emits the RF signal and the received tag response. If the situation is normal, the microcontroller sends the information of “the equipment is tracked” to the web-connected database at a pre set interval of time, for example every one hour. The data can be sent through the wired communication channel or wireless communication channel. At the central station, the operator can access the web-connect database and choose to display the following information by text or by graphical picture:

- (1) The current location of all equipments in a specified area.
- (2) The current and the historic information of the location of a specific piece of equipment.
- (3) The location of a piece of equipment at the specified previous time.

### 2.2 Emergency mode

If the RFID reader stops receiving the response from the tag, the equipment is off the tracking system, the microcontroller sets the system in the emergency mode.

- (1) The microcontroller raises the sound and/or light alarm.
- (2) The microcontroller sends the short message or makes a phone call to the response operators and /or the central station.
- (3) The information of the emergent mode is sent to the web-connected database. This information includes the time of the emergency event occurrence, the

identification code of the equipment, and the previous tracked location of the equipment and so on.

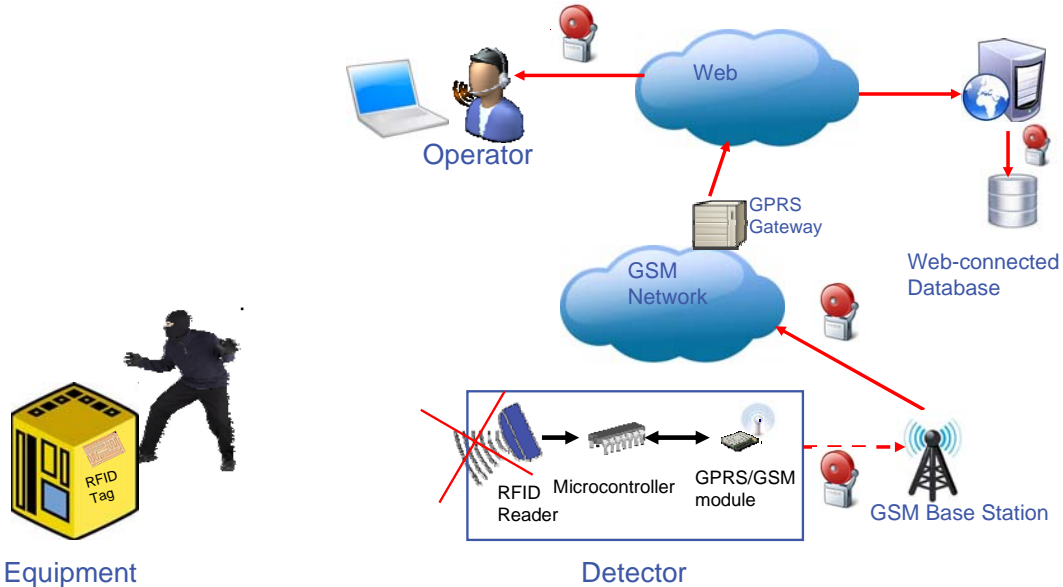


Fig. 2

### 2.3 Diagnostic mode

The diagnostic mode is entered from the normal operation mode. The purpose of the diagnostic mode is to guarantee the communication between the detector and the central station is always established. It is a random number based diagnostic method (IKM patent). The procedures are as follows:

- (1) The computer in the central station generates a pair of random numbers, the first number is sent to the detector, the second number determines which channel is used to send the first random number.
- (2) When the detector receives the random number, it will send the same number back to the central station.
- (3) If the central station obtains the sent back number for a pre-defined period of time and the number obtained is the same to the one sent out, that means the communication is normal. If not, some problem occurs in the communication channel, and the computer in the central station will alarm the operators to take responsive actions. The three steps will be repeated in a infinite loop.