

# Design of Integrated Urban Management System and its Applications Based on RoF and PON Technologies

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## Abstract

A variety of systems have been attempted for effective urban management. In this paper, we introduce integrated urban management system (IUMS), which mainly consists of optical line terminal (OLT), optical network terminal (ONTs) and wireless access points (APs), by combining passive optical network (PON) and radio over fiber (RoF) technologies so as to take advantages of both two systems. Further, several IUMS services including disaster detection and prevention system (DDPS), bus information system (BIS) and real time location system (RTLS) are demonstrated in order to employ IUMS for the realization of future ubiquitous city (U-city).

## I. Introduction

Recently, as city have become more complicated, the demands has arisen for effective urban management such as maintaining public security, detecting and protecting disasters, and providing ubiquitous communication services [1]. Also, it is inevitable to integrate the systems, which target for a specific need under single communication network to realize of extensive urban management.

In this paper, the urban management system is introduced to resolve those situations by the hybrid of passive optical network (PON) and radio over fiber (RoF) systems, and it is denoted as Integrated Urban Management System (IUMS). Further, several applications of IUMS like Bus information system (BIS), disaster detection and prevention system (DDPS) and indoor or outdoor real time

location system (RTLS) are demonstrated to show its versatile usages.

## II. Architecture of IUMS

Fig. 1 shows overall architecture of IUMS. It mainly consists of two parts, optical and wireless systems. The optical system is implemented by gigabit Ethernet PON system consisting of one optical line terminal (OLT), a fiber distribution splitter and several optical network terminals (ONTs) [2]. The OLT is equipped in the IUMS control center and the fiber distribution splitter can be located indoor or outdoor of IUMS control center. In IUMS control center, several network servers are employed to preserve information or provide many services to end users. In the outside of control center, we can consider two cases, wireless indoor and outdoor.

## III. Applications of IUMS

### 1. DDPS service using IUMS

Disaster detection and prevention system (DDPS) service based on IUMS provides several services including detecting public buildings or structures which are threatened by severe disasters employing wireless sensor network (WSN). For example, wireless sensor motes sensing twisting angle, vibration, or safe loads are attached to the bridge, and they sends the information to wireless AP. After processing several hops, the detected

information is optically passed to IUMS control center.

## 2. BIS service using IUMS

We employ IUMS to one of common transportation as bus information system (BIS). The bus sends its location information, emergency call by using bus wireless AP to IUMS control center. Then, IUMS control center gathers total information from different buses, and broadcasts real-time bus location information to other buses or bus stops.

## 3. RTLS service using IUMS

Real time location service is also executed by applying IUMS. The location information is obtained both indoor and outdoor by using wireless communication techniques such as global position system (GPS) and base transceiver station (BTS) systems or RFID based location tracking systems based on WI-FI or UWB. Upon keeping tracking stolen cars or criminals, IUMS can easily monitor and detect their right positions.

## IV. Conclusions

In this paper, we have introduced IUMS for urban management based on PON and RoF technologies. Although IUMS is exemplified by only three services including BIS, DDPS and RTLS, other applications are freely interconnected to IUMS since it has highly scalable and upgradable. Namely, additive services for urban management are required, they can be achieved providing that the number of ONTs and wireless APs are additionally deployed. This is possible by realizing

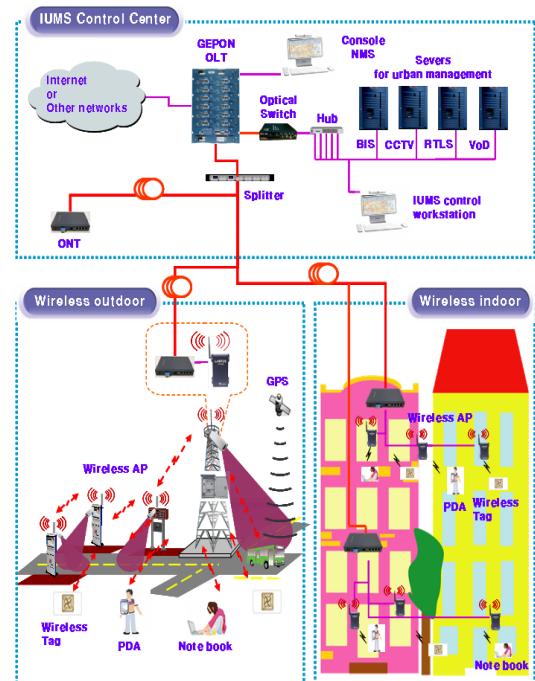


Fig. 1. Overall architecture of IUMS.

super PON where several sub-OLTs are connected to main OLT to increase the number of ONTs so that the amount of wireless APs or wireless applications are significantly increasing. However, there is a still limitation in IUMS, the limited data rate of wireless APs which may induce bottleneck problem among end users. Therefore, we should consider the development of wireless AP which guarantees reliable and high data rate communication in the sequel of this paper.

## References

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