

## Research on Wireless Sensor Network Module Based on IPv6

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**Abstract.** It is very important to develop concentrator, router, hardware and software of wireless module in networking of power information collection system. In this paper, the hardware and software of module are researched and designed in electricity information collection system based on IPv6 wireless sensor network. Radio frequency chips that are suitable for 470-510MHz are used. 802.15.4g criterion is adopted in physical layer and MAC (Media Access Control). Moreover, 6LoWPAN protocol is used in upper layer.

### Introduction

With the wide popularity of smart grid across the whole of China, electricity information collection system plays a crucial role in safe grid operation and orderly power utility. Meanwhile, it is a basic application system of intelligent power service [1]. Moreover, it includes master station, channel, concentrator, collector and electric energy meter. Local channel is used for connecting on-site terminal with meter. It can adopt power line carrier, RS-485 and micro-power wireless networks [2]. Presently, master station can't measure electric energy meter with fixed point in flooding meter reading. In other words, it can't measure electricity consumption data of meter, information of anomalous event and update remote software development procedure [3][4]. In this paper, hardware and software of module are designed based on IPv6 wireless sensor network. It includes structure design, interface design and data physical design in wireless communication module of built-in concentrator [5]. The bottom of designed micro-power wireless communication module supports 802.15.4g, and adopts national civil wireless measurement meter with frequency band 470-510MHz. The general scheme of system is shown in Fig.1.

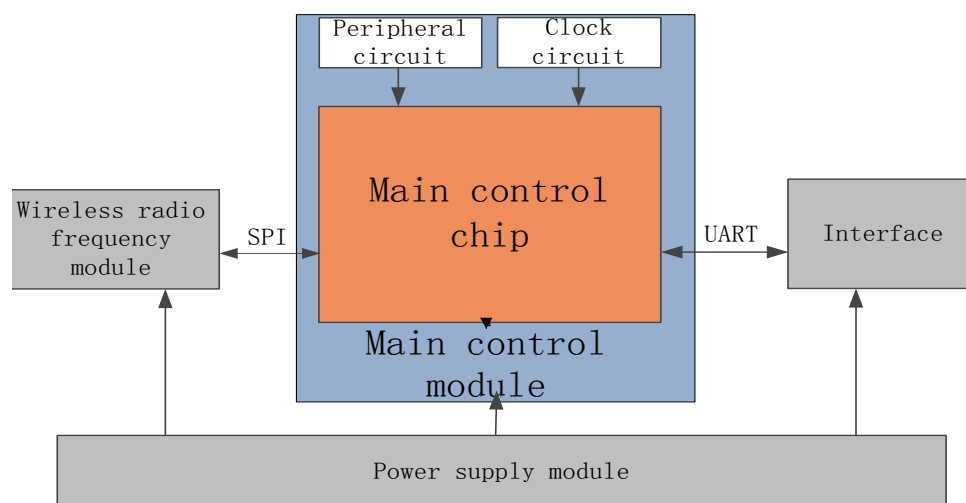


Fig.1. The general scheme of wireless module

### IPv6 Protocol

#### IPv6 protocol

IPv6 (Internet Protocol Version 6) is also named next internet protocol. IPv6 obviously

improves quality of service, such as site capacity, security, administration of networks and mobility. Embedded IPv6 protocol stack is divided into four layers. Function of each layer is sketched as following [6]:

1) Network Devices Driver Interface Layer. It mainly controlled corresponding physical medium, and realized data link. Therefore we can do various setup in physical medium, and receive or send data through physical medium.

2) Network Interface Core Layer (NIC). It can shield many physical mediums, and provide uniform transmission interface for upper layer.

3) TCP/IP Network Protocol Layer. It is the transport layer protocol and network layer protocol of TCP/IP model. It realized data transfer and data packet sending among nodes. Moreover, it guaranteed data reliable transmission.

4) Event Trigger Interface Layer. It is a simple network management protocol, and it can specify network application or network data format.

The function that upper layer calls adjacent layer can realize corresponding action of the whole protocol stack. The hierarchy of protocol is shown in Fig.2.

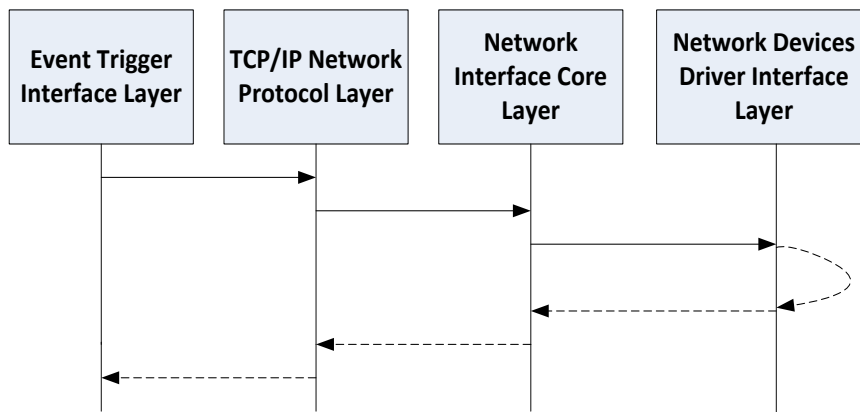


Fig.2. The protocol's hierarchy object sequence chart

### 6LoWPAN protocol

Wireless communication module protocol stack is based on 6LoWPAN protocol stack model [7][8]. It is shown in Fig.3. It supports IEEE802.15.4g criterion. The equipment, network topology, communication characteristic, service interface and function supported by this protocol stack, which should abide by Q/GDW1376.4 criterion of state grid corporation of China or other stricter technical indicators.

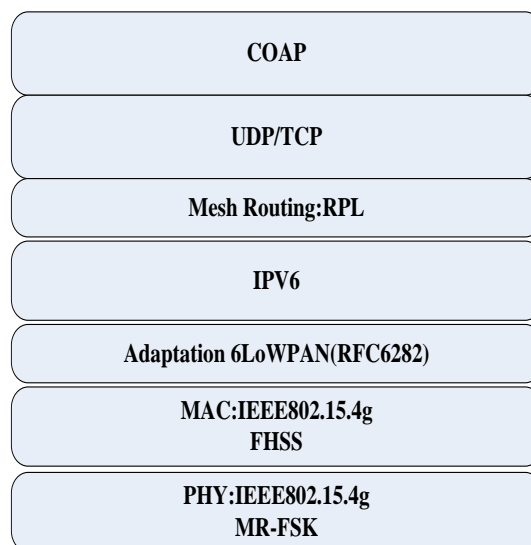


Fig.3. Wireless communication module protocol stack

## Structure Design

The hierarchical structure of whole module is shown in Fig.4.

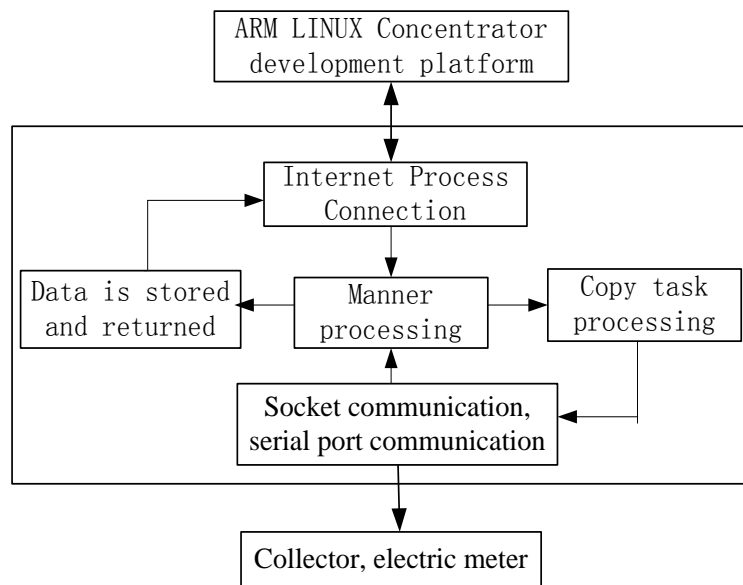


Fig.4. The hierarchical structure of module

The module provides many services, such as multitask scheduling, collection channel management, data management and inter-process communication services [9][10]. According to realized function, the module can be divided into multiple sub-modules, such as statute processing module, inter-process communication module, socket communication module, data dictionary management module, copy task module and channel detection module.

### 1) Statute Processing

It can uniformly process terminal uplink communication statute, inter-process communication statute, downlink collection communication statute and electricity meter statute. It also can realize transition among several statutes according to requirement. Every statute has a unique ID. It is packed by dynamic chained library. Therefore, it provides integrated function packaging library for data collection or storage.

### 2) Inter-process Communication

It can receive and dispatch inter-process data with others. Channel is established or destroyed according to uniform data interface of system.

### 3) Data Dictionary Management

It mainly manages electricity meter file information, including the relevance between electricity meter file and collector file.

### 4) Multitask Management

It mainly dispatched task data. It also framed or sent data according to the content of task data queue.

### 5) Collection Channel Management and Detection

If electricity meter includes the relation between meter and collector, module directly acquired IP information of collector by electricity parameter file, and also provided channel for data collector. Otherwise, module acquired IP information of collector by other progresses, and realized the match between electricity meter file and collector information.

## Interface Design

### Inter-process Communication Interface

The interface interacted software data with main dispatch. It can realize channel connection, channel close, transmit-receive data and exception handling. Communication adopts user-defined patulous protocol. It used uniform data interface, and module has itself channel ID number. Inter-process communication interface is shown in Fig.5.

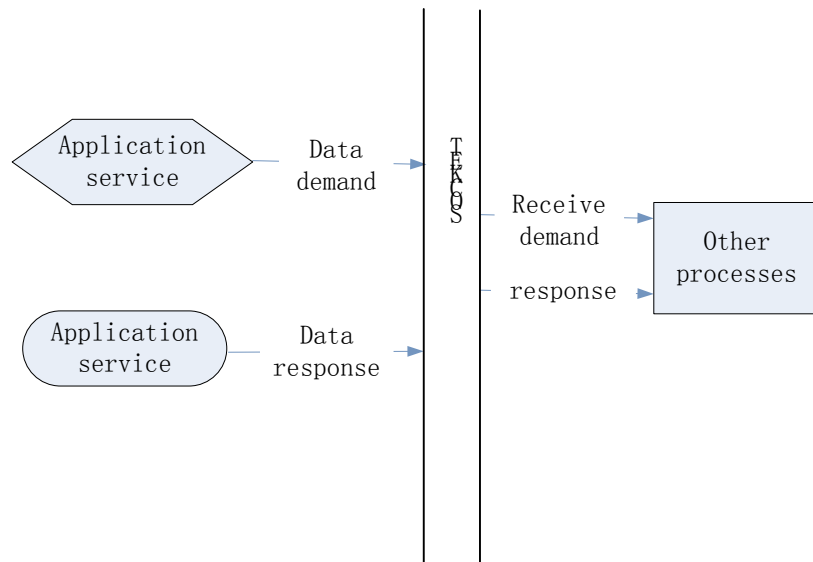


Fig.5. Inter-process communication interface

### Collection Communication Interface

Modularization design is adopted in the communication of collector. It realized data interaction by function interface. Communication protocol used “Q/GDW collector local communication module interface protocol”. Module is connected by independent data structure. The function of data interface is listed in Tab.1.

Tab.1. Collector Data Interface Function

number	Name	Function role
1	Recv_data	It received collector data. When receiver is abnormal, connection is closed.
2	SendData_Comm	It sent data to collector. When connection has been established, data is sent directly. Otherwise it should establish a connection firstly.

### Data Structure Design

#### 1) Electricity Meter File Management

It is responsible for relevance and management between electricity meter file and collector file. Data structure is same as management unit of collector. Collector is belonged to electricity meter, and they are correlated by the unique identification ID of collector.

#### 2) Collection Task Data Management

It manages the parameters that are relevant with copy task. It also selects the data obtained from system according copy mechanism.

#### 3) Collection Data Item Management

It manages real time and timed data from copying. It regards electricity meter as management unit. It includes all collection data items of electricity meter.

#### 4) Collection Channel Data Management

It manages collection information and connection information of collector.

#### 5) Return Collection Data Management

It conducts buffer-processing for the return data uniformly. Then it does further processing according to manner data structure.

#### 6) Collector Receiving Data Queue

Collector receives data management, and is manly used to concurrence copy.

#### 7) Manner Data Structure

It stipulates corresponding data format according to the requirement of 698’s data format. It is

used for switching internal data. Data structure is same as data format of 698 FN item. The data unit format of present forward direction useful power energy value (total, rate 1~M) is listed in Tab.2.

Tab.2. The data unit format of present forward direction useful power energy value (total, rate 1~M).

Data content	unit	Number of bytes
Terminal reading meter time	Minute Hour Day Month Year	5
Rate number M	number	1
forward direction useful power energy value	kWh	5
Rate 1 forward direction useful power energy value	kWh	5
.....	.....	.....
Rate M forward direction useful power energy value	kWh	5

## Conclusion

This paper is aimed at hardware design based on IPv6 wireless sensor module. It includes router design, concentrator design and concentrator software totality copy module. That is, structure design, interface design and data structure design are developed. It designs a module that bottom supports 802.15.4g. It adopts national civil wireless metering device. It uses 470-510Mhz micro-power wireless communication. Because the compatibility of original IPv4 protocol is different from IPv6, electro-information collection system should be further considered and researched in central master station, communication protocol, terminal devices and communication network. Finally it can form an electro-information collection system that meets various requirements.

## Acknowledgement

During the period of module test, we used the software titled “SmartSignalProcessing” to process the signals from the wireless sensors, especially for the noises and interferences. Such software is developed by prof.Ming-Yue Zhai at school of Electrical and Electronic Engineering, North Chain Electric Power University.

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