

ZIGBEE GATEWAYS

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ABSTRACT

This paper describes ZigBee architecture founded on IEEE 802.15.4 standard. The kernel of this contribution deals with ZigBee gateway which interconnects ZigBee networks with Intranet or Internet.

1 INTRODUCTION

ZigBee is a published specification set of high level communication protocols designed to use small low power digital radios based on the IEEE 804.15.4 standard for wireless personal area networks (WPANs). IEEE 804.15.4 is part of object-oriented architecture IEEE 1451 [1, 3]. IEEE 1451 consists of the family standards for a networked smart transducer interface [4, 5, 6]. The ZigBee stack architecture is made up of a set of blocks called layers. Each layer performs a specific set of services for the layer above. The ZigBee stack architecture is based on the standard Open Systems Interconnection model. ZigBee architecture defines only those layers relevant to achieving functionality in the intended market space. The IEEE 802.15.4 standard defines the lower two layers: the physical layer (PHY) and the medium access control sub-layer (MAC). The ZigBee Alliance builds on this foundation by providing the network layer and the framework for the application layer, which includes the application support sub-layer, the ZigBee device objects and the manufacturer-defined application objects [7].

The responsibilities of the ZigBee network layer shall include mechanisms used to join and leave a network, to apply security to frames and to route frames to their intended destinations. In addition, the discovery and maintenance of routes between devices devolve to the network layer. Also the discovery of one-hop neighbors and the storing of pertinent neighbor information are done at the network layer. The network layer of a ZigBee coordinator is responsible for starting a new network, when appropriate, and assigning addresses to newly associated devices.

The ZigBee network layer supports star, tree and mesh topologies. In a star topology,

the network is controlled by one single device called the ZigBee coordinator. The ZigBee coordinator is responsible for initiating and maintaining the devices on the network, and all other devices, known as end devices, directly communicate with the ZigBee coordinator.

2 ZIGBEE NETWORK INTERFACE

According to the ISO Open Systems Interconnection vocabulary, two or more sub-networks are interconnected using an equipment called as intermediate system whose primary function is to relay selectively information from one subnetwork to another and to perform protocol conversion where necessary. A bridge or a router provides the means for interconnecting two physically distinct networks, which differ occasionally in two or three lower layers respectively. The bridge converts frames with consistent addressing schemes at the data-link layer while the router deals with packets at the network layer. Lower layers of these intermediate systems are implemented according to the proper architectures of interconnected networks. When subnetworks differ in their higher layer protocols, especially in the application layer, or when the communication functions of the bottom three layers are not sufficient for coupling, the intermediate system, called in this case as gateway, contains all layers of the networks involved and converts application messages between appropriate formats.

3 ADDRESSING AND ROUTING IN ZIGBEE

All devices in the ZigBee network must have unique 64 bit IEEE addresses. Short 16 bit address can be allocated to reduce packet size. With using this local addresses, simple network have more than 65000 nodes, which they can be configured with reduced address overhead. Only the 16 bit address is used to route packets within the network. The addresses depend on topology of networking. When it is used star topology, the address field consists from network information and device identifier. When other topology (cluster tree or mesh) is used, than address field consists from source and destination identifier.

The ZigBee routing algorithm uses a path cost metric for route comparison during route discovery and maintenance of nodes. In order to compute this metric, a cost, known as the link cost, is associated with each link in the path and link cost values are summed to produce the cost for the path as a whole. ZigBee routers and ZigBee coordinator may maintain a routing table. A ZigBee coordinator and ZigBee router may also reserve a number of routing table entries to be used only for route repair and only in this case all other routing capacity has been exhausted.

Field Name	Size	Description
Destination address	2 bytes	The 16-bit network address of this route
Status	3 bits	The status of route
Next-hop address	2 bytes	The 16-bit address of the next hop on the way to the destination

Tab. 1: *Routing table*

On receipt of a data frame the network layer routes it according to the following algorithm:

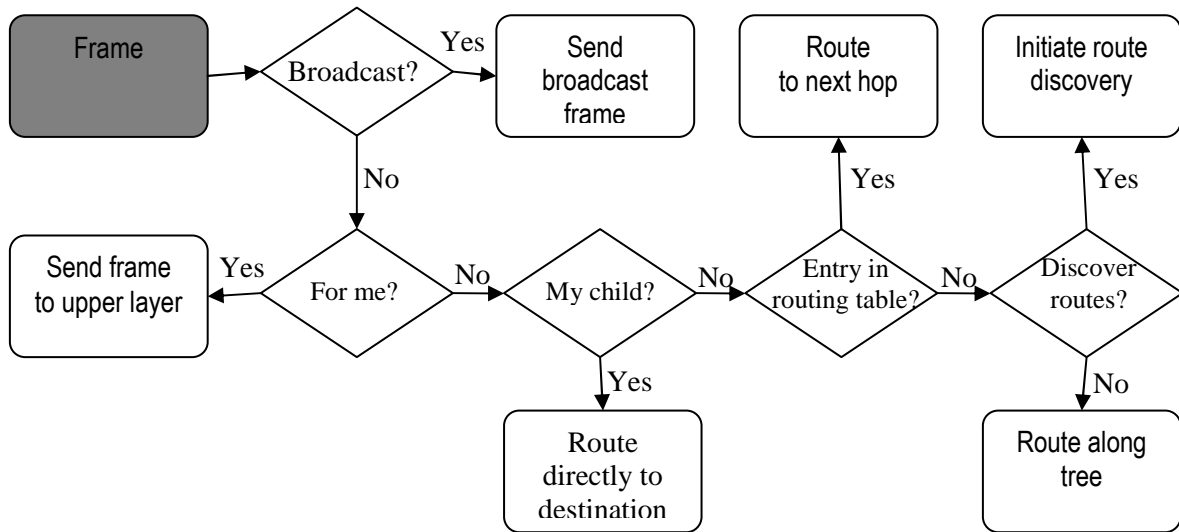


Fig. 1: Routing algorithm

4 ZIGBEE GATEWAY

In context of ZigBee, Gateways provide a full featured connectivity and allow a greater diversity of devices and applications to connect to the ZigBee network. Gateways convert the wireless protocols and sensor data into the myriad of formats necessary for industrial, commercial, and residential systems and allow wireless sensor networks to use wireless protocols such as ZigBee that are well suited for the harsh RF environment as well as battery powered applications and allow them to be integrated into existing applications [2].

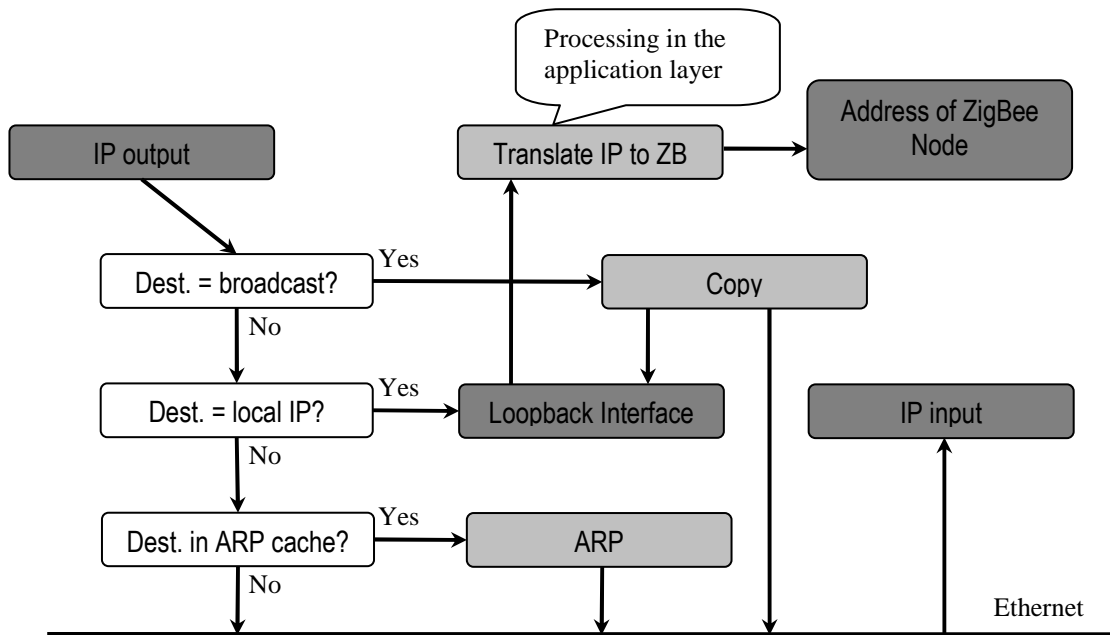


Fig. 2: Transmission of a frame on the ZigBee Gateway

When the gateway receives an IP packet, then the operation system on gateway checks the destination address. If the destination address is a type of broadcast address then the system must receive a copy of the packet. This happens if this is an IP network broadcast address (or a multicast address is used that matches one of the registered IP multicast filters set by the IP receiver). If a copy is required, it is sent to the loopback interface. This directly delivers the packet to the IP input routine. The original packet continues to be processed. In other way if the IP address is an unicast address, system receives the IP packet to the loopback.

During the translation IP packet to ZigBee frame, packet is transmitted to application layer, where user application is running. Packet is processed by the application and this application chooses a set of sensors, which the packet will be sent to.

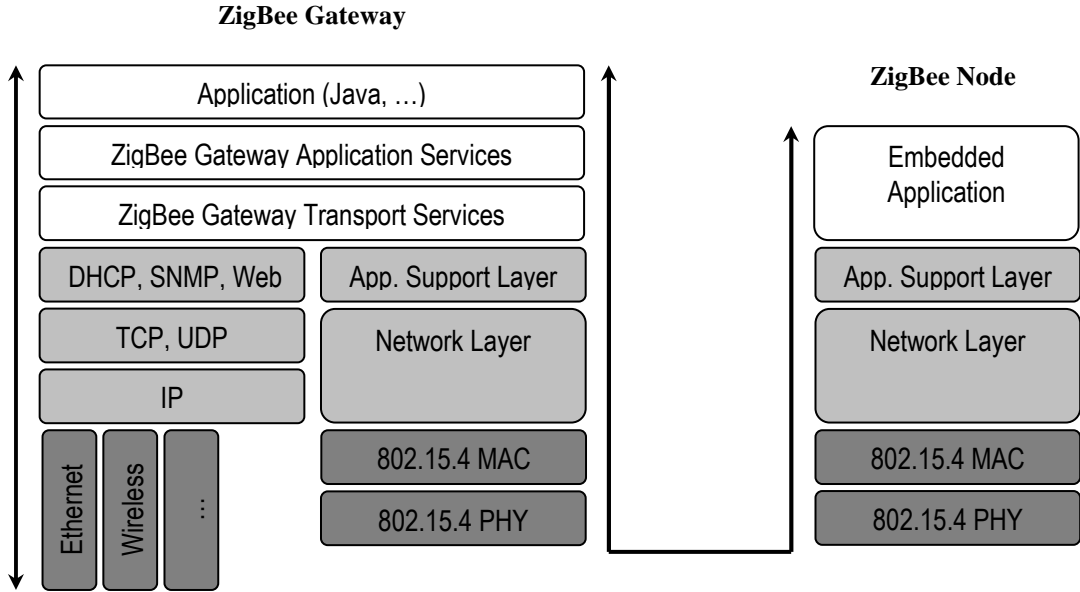


Fig. 3: Stack diagram of ZigBee gateway

5 CONCLUSION

This paper deals with sensor networking frameworks founded on IEEE 802.15.4 architecture for wireless sensors networks. The contribution is focused to ZigBee specification, namely to architecture of gateway, which enable mediating an access from an Intranet to sensors. Standardization of ZigBee devices will permit multiple vendors to interoperate and provide a superior solution to ZigBee users. IEEE 802.15.4/ZigBee is intended as a specification for low-powered networks for such uses as wireless monitoring and control of lights, security alarms, motion sensors, thermostats and smoke detectors.

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