Research and Implementation of Connectivity between the 6LOWPAN Subset and IPV4 Internet Based on CONTIKI

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Abstract. 6LowPAN provides IPv6 internet protocol over IEEE 802.15.4. The Internet of things support IPv6 protocol, the current internet primarily supports IPv4. Network Address Translator-Protocol Translator (NAT-PT) technology is integrated in 6Lowpan gateway to support data packet conversion. Internet and internet of things can complete interconnection through NAT-PT. This paper describes the implementation of the connectivity platform, and gives connectivity test results.

Introduction

6LoWPAN is an acronym of IPv6 over low power wireless personal area networks; it provides IPv6 internet protocol over IEEE 802.15.4 standard. The 6LOWPAN group has defined encapsulation and header compression mechanisms that allow IPv6 packets to be sent and received in the wireless sensor networks (WSN). The base specification developed by the 6LoWPAN IETF group is RFC 4944[1]. WSN are spatially distributed sensors that cooperatively pass their data through the wireless network to a main location. 6LoWPAN subnet would be able to connect with the Internet seamlessly.

6Lowpan technology is widespread concerned by academia and industry, such as the University of California Berkeley, Switzerland Computer Science (Swedish Institute of Computer Science), Cisco, Honeywell, and other famous enterprises. The most famous is Contiki [2] and Tinyos. Contiki is developed by Adam Dunkels, who works in the Switzerland Computer Science. He achieve a complete 6LoWPAN protocol stack. Contiki is an open source operating system. Research of this paper is based on this operating system.

However, IPv4 protocol is still dominant in the internet, resulting in a transition from IPv4 to IPv6 is a gradual process; the vast majority of applications are still based on IPv4. So, this paper studies that the IPv6 6LOWPAN how to interconnect with IPv4 internet.

NAT-PT[3] is a technology that can translate IPv6 addresses into IPv4 addresses, and vice versa. NAT-PT is based on RFC2766 defined Stateless IP / ICMP converter (SIIT) algorithm. In this paper, we use NAT-PT technique to design the address converter to assign the IPv4 address for the 6Lowpan node that wants to access the ipv4 internet node dynamically.

6LoWPAN Internet Access Subnet Architecture

The architecture of 6Lowpan subnet that access IP4 internet is showed in Figure 1. 6LowPAN system needs a gateway, 6LowPAN node module, and an internet server. The Contiki[4] IPv6 protocol stack is running on the 6LowPAN node module. The gateway is a NAT-PT gateway. It is the bridge that Links 6LoWPAN networks and the Internet. It runs IPv4 and IPv6 dual stack. NAT-PT Gateway are running IPv4 protocol stack to support Internet access.
6LowPAN gateway has a WAN port and a LAN port. The WAN port can directly access the Internet, and support IPv4 and IPv6. All 6Lowpan nodes in the network share a single WAN port. The NAT internal table is created in the NAT-PT gateway to finish the transition between the IPv4 and IPv6 address. LAN port is 6LowPAN radio interface, which acts as a RPL Root, automatically assigns IPv6 addresses to other nodes. It is equivalent to RPL tree topology of the root node, the starting point for the establishment of the entire RPL topology.

6LowPAN nodes mainly support the specific features of sensors. The application of the 6LowPAN node module is UDP, so the server software is usually developed as a UDP application. When 6LowPAN node wants to access the Internet, it transmits data to the root node directly into the WAN port, and vice versa.

6LowPAN Interconnection Implementation

Hardware Environment

The system has the following four entities: 1 PC; 1 boundary 6LoWPAN gateways; a number of 6LoWPAN sensor nodes.

Software Environment

The pc supports windows 7-10. 6Lowpan Gateway supports RPL root node to provide IP forwarding storage, NAT-PT protocol. 6lowpan nodes provide contiki kernel. This system is mainly on contiki operating system. The Ipv6 protocol stack has been modified. NAT-PT module is joint into the contiki.
6LoWPAN Experimental testing

Connectivity Test
To test the basic functionality of edge 6lowpan gateway, experiment platform is shown in Figure 2. In the 6lowpan subnet, 6Lowpan wireless nodes support IPv6 and are configured to support the RPL routing protocol. Default route for all 6Lowpan wireless nodes are edge routing device, its IPv6 address is 2001::1/64. Window 7 PC IPv6 address is 2001::6/64. The gateway address is 2001::1.

![Figure 2. 6Lowpan connectivity test experiment environment.](image)

6Lowpan wireless nodes use the ping command to test the interoperability with IPv4 internet. You must ensure the PC and 6LoWPAN gateway connection in the same switch. You can ping the gateway address of the next 6LoWPAN. The results are shown in the Figure 3.

![Figure 3. 6Lowpan ping Gateway.](image)

If you want to Ping a node, you can see the following results in the Figure 4.
Therefore, we use Mysniffer 154 server+Wireshark to catch bag, as shown in Figure 5.

Through testing, we proved the correctness of the protocol design and connectivity.

Summary
In this paper, we use NAT-PT technique to design a platform to support the connectivity between the 6lowpan wireless nodes and ipv4 internet. The 6lowpan protocol is implemented on contiki. We tested its connectivity. We can use this platform to achieve interoperability and integration of Internet and Internet of Things.

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References