The System Design and Performance Analysis of WiMAX Base Station MAC Based on Intel Network Processor

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Abstract

This paper provides WiMAX BS (base station) MAC system design and performance analysis based on Intel IXP2350, which includes MAC design key issues discussion, base station usage model and architecture, MAC hardware and software high level design with performance analysis. Especially, the WiMAX base station is user-specific, and WiMAX MAC software is one of the most important base station components, so we discuss in details about MAC data plane software design and performance pre-analysis based on IXP2350 micro engines. Current hardware GE forwarding test and data plane software pre-analysis shows that the design scheme can meet system performance requirement.

1. Introduction

WiMAX (Worldwide Interoperability for Microwave Access) Technology is based on the IEEE 802.16-2004 [1] and 802.16e [2] standards. WiMAX can provide capability of maxim 75Mbps data rate and 50km coverage range.

As key component in WiMAX networks, WiMAX BS (Base Station) design major issue is WiAMX MAC layer implementation. The reasons are complexity of 802.16 protocols and lack of design reference and applications. For WiMAX BS MAC design, we need solve below two problems:

First is suitable CPU system selection, which can be met complexity procedure of protocol and relevant data flow and system performance requirements.

Second is system performance evaluation.

Based on above considerations, we select Intel IXP2350 [3] network processor in MAC design, as IXP2350 is flexible and reprogrammable embedded processor with multi-core and configurable interfaces.

2. WiMAX BS system design

2.1. WiMAX network data flow and protocols

The entire WiMAX network data flow and relevant protocols are shown as below Figure 1.

2.2. WiMAX BS hardware system design

Our multi sector WiMAX BS hardware design block diagram is shown as below Figure 2.

2.3. WiMAX BS software system design
The MAC data plane software procedures are shown as below Figure 3.

3. Data plane performance pre-analysis

ME headroom analysis data is shown in Table 1.

<table>
<thead>
<tr>
<th>Module</th>
<th>Available headroom</th>
<th>Total utilization</th>
<th>ME0</th>
<th>ME1</th>
<th>ME2</th>
<th>ME3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data plane</td>
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<tr>
<td>MAC data plane software</td>
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<td>Hardware GE forwarding</td>
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</tbody>
</table>

Resource utilization summary is shown in Table 2, which also shows ixp2350 IO ACCESS and instruction cycle can meet system requirements.

Table 2. Estimated Resource Utilization Summary

<table>
<thead>
<tr>
<th>Resource Use</th>
<th>Available headroom</th>
<th>Total utilization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core#0</td>
<td></td>
<td></td>
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<tr>
<td>Core#1</td>
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<td>Core#2</td>
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<td>Core#3</td>
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<tr>
<td>Core#4</td>
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<tr>
<td>Core#5</td>
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</tbody>
</table>

4. Conclusion

In this paper, we provided a detailed description of WiMAX base station MAC hardware/software design, hardware GE forwarding performance test, data plane resource allocation and performance pre-analysis.

Intel network processor IXP2350 based design enables WiMAX MAC to perform high data throughput and very scalable architecture to meet different standard options and service requirements.

WiMAX MAC poses significant challenges to the base station software implementer. Hard real-time deadlines must be met while still maintaining high throughput and predictable behavior, at the same time, complicated QoS and scheduling policy are also quite difficult issues, which will be our future development focus.

On the other hand, as current software development is still in system and high level design stage with few coding efforts to verify ME/threads rationality and performance pre-analysis, we need more efforts to fulfill real running WiMAX BS MAX system.

5. References