LTE eNB Scheduler

Advanced library for radio resource management

Overview

LTE eNB Scheduler is an advanced software library realizing functions of a base station scheduler. It interacts with the LTE eNB Stack through a Small Cell Forum (former Femto Forum) compliant interface (FAPI) extended to support Carrier Aggregation. Thanks to that LTE eNB Scheduler can be used together with LTE eNB Stack or with other customer-specific eNB protocol stacks. LTE eNB Scheduler implements two configurable scheduling algorithms including an advanced channel-aware proprietary scheduling algorithm designed for performance, as well as a simple round robin scheduling algorithm designed for benchmarking.

LTE eNB Scheduler library is implemented in ANSI C (C99) using the latest industry standards for improved safety and performance. LTE eNB Scheduler runs on any processing environment providing threading support. For those customers who aim at integrating our LTE eNB Scheduler with their own eNB protocol stacks, we provide integration support service.

Table 1: Schedulers comparison

<table>
<thead>
<tr>
<th>Algorithm/Component</th>
<th>Round Robin</th>
<th>maxCQI</th>
<th>Proportional Fair</th>
<th>M-LWDF</th>
<th>M-QBER</th>
<th>LTE eNB Scheduler</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel conditions</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Historical throughput</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Packet delay</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Queue length</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>GBR/non-GBR traffic</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Carrier Aggregation*</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Wrong CQI correction</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*) support for Carrier Aggregation means ability to activate/deactivate second component carrier

Table 1 shows a comparison of various schedulers including our product, based on criteria of taking into account selected parameters and measure in making a scheduling decision.
Applications

<table>
<thead>
<tr>
<th>Application</th>
<th>Benefit</th>
<th>Who can benefit?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small cell base station development</td>
<td>LTE eNB Scheduler shortens significantly development time of a small cell base station</td>
<td>ODM, OEM, Research Institute</td>
</tr>
<tr>
<td>R&amp;D</td>
<td>LTE eNB scheduler allows for research on radio resource management</td>
<td>Research Institute, ODM, OEM, Operator</td>
</tr>
</tbody>
</table>

Technical specification summary

- Implemented based on extended Small Cell Forum recommendation
- Includes two scheduler algorithms:
  - Simple (Round Robin, perfect for benchmarking)
  - Advanced (channel-aware, IS-Wireless proprietary)
- Main features of the advanced algorithm:
  - Support for Carrier Aggregation – activation and deactivation of component carriers
  - Ability to guarantee GBR traffic
  - Real-life imperfection corrections – wrong CQI reporting compensation
  - Multiple priority components
  - Parametrization (maximizing eNB throughput, fairness, minimizing latency)
  - 30% higher peak throughput with maintaining edge cell users performance
  - Higher total throughput for any number of users
- Parameters taken into account by the advanced algorithm:
  - Radio propagation conditions
  - Packet delays
  - UE historical throughput
  - Queue size
  - UE quality of service (GBR/non-GBR)
  - UE capabilities
  - Tested in various environments

Deliverables

LTE eNB Scheduler is delivered as a library compiled for desired architecture that can be further linked with the protocol stack binary.

Figure 1: LTE eNB Scheduler main functionalities

Figure 2: Peak and cell edge user throughput

Figure 2 shows comparison of peak and cell edge user throughput between LTE eNB Scheduler and benchmark algorithms. User throughputs are normalized for peak user throughput for Proportional Fair algorithm. Using this normalization allows to show gain obtained with LTE eNB Scheduler. Our algorithm’s performance is 35% better than Proportional Fair in terms of peak user throughput without degrading cell edge user throughput.

About IS-Wireless

IS-Wireless is a globally operating Polish software developer and IP provider specializing in advanced solutions for wireless systems. IS-Wireless develops 4G and 5G algorithms, protocols and tools.

Our clients are primarily early technology adopters including ODMs, OEMs, chip vendors, and operators. We deliver our services to companies and organizations from Europe, USA, Africa and Asia. The company is engaged in EU FP7 projects on 5G and is active in delivering technical courses on advanced telecom.

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